



THE RIVER VALLEYS OF THE MALTESE ISLANDS

ENVIRONMENT AND HUMAN IMPACT

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GOVERNMENT POLICIES

Interweaving cultural and artistic expression, portraying the relationship among lands, rivers and people.... values are formed and expressed by the myths, symbols, rituals and artistic expressions of particular groups.

Working closely with all interested and the public, we need to create the conditions that will sustain the use and enjoyment of riparian systems for the benefit of future generations of humans, wildlife populations and vegetation communities.

*(United States Department of Agriculture,
Forest Service, 1993)*

Because of the importance of the local widien in terms of water resources, agriculture, wildlife, landscape and soil erosion, pollution and leisure, it is strongly recommended that special land use structure be made of these systems.

In terms of natural resources, areas which should not be developed at all, or where development should be rigidly controlled in line with policies to be specified in the Structure Plan, include,.....All valleys.

These natural assets should be identified and advertised as such to tourists who should be encouraged to visit them.

Degrading areas should be improved by pinpointing the factors causing degradation and controlling them.

Country walks through scenic areas and those of natural interest should be defined and sign-posted.

(The Malta Structure Plan, 1990)

Lil Malta

Għalkemm ġejt minn art sabiha,
Art li thaddar ma kull żmien,
Art li minnha saret qalbi,
Li ngħib miegħi kullimkien,
Daqs il-ghasel sibtek helwa
Bint il-bahar, bint ix-xemxgħ
Malta, Malta, warda bħalek,
Sbejha u żghira, ngħid li m'hemmx

O. Friggieri

Free translation

To Malta

Although I come from a beautiful land,
A land which greens with every time,
A land from which my heart was made,
Which I carry with me everywhere,
I have found you as sweet as honey,
Daughter of the sea, daughter of the sun,
Malta, Malta a rose like you,
Beautiful and small, I do not think there is another.

Lill-Wied tal-Lunzjata, Għawdex

Kelli nerga' narak, Wied, fejn jitqaddes
Daqs xejn ta' maqdes ma' ġenbejn il-blat
Fejn sabet ilma jserrep, u b'ghanjietu
Jegħleb tad-dinja s-sejha w il-fruġhat.

Is-Sliem għalik! Minn ġenb għall-iehor, l-ghana,
Jimla, jidwi, fin-nir tas-sema jdubgħ
Tghanni n-nixxigha qalb il-qasabgħ ighannu
L-aghsafar u l-werżieq qalb il-hamub.

G. Zammit

Free translation

To the Lunzjata Valley, Gozo

I had to see you again, valley, in which is
ensconsed a small chapel beside the rocky side,
Where a small stream snakes, and with its song,
O'er comes the worldly call for vanity.

Hail! from one side to another, the tune
Fills up, echoes, and melts the blue skies;
The spring sings melodiously as it passes through the canes
The birds and cricket sing in the carobs.

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FOREWORD

One does not nowadays easily associate the Maltese countryside with images of rivers, streams and flowing water. And yet as recently as 160 years ago, most of the hundreds of kilometres of river valleys (widien) that intersperse our landscape were active water-courses along which a wealth of natural life flourished and agrarian communities prospered.

Time has dried up the rivers, but the valleys they left behind still enjoy the wealth of the legacy of life that water always generates. From the primary vegetation and the fauna that thrives on it, to the man-made relics of a riverbank culture such as chapels, farms, cart-ruts, dams and bridges, these widien boast a river heritage which is more concentrated than in any other area in Europe.

The importance of these valleys has not however diminished with the disappearance of the rivers. The gentle sloping sides are conducive to crop growing and other agricultural activities, thus creating the characteristic landscape particular to our islands. The valleys have fertile habitats that support ecological systems worthy of our full attention and protection, while their role in recharging the water table by virtue of their geology and structure should not be ignored.

In this book, Sylvia Haslam, a leading international authority on river valleys, has joined forces with Joe Borg, who has devoted a lifetime to the study of the Maltese countryside, to bring us the combined wealth of their applied studies and experience. They describe the valleys and their environment, explaining the natural and cultural wealth of their heritage. They have also gone into the issue of the use and misuse of the widien, their agricultural importance as well as the harm now being inflicted on them by the

destruction of rubble walls and the dumping of waste.

Such a publication should serve as a landmark in the appreciation and understanding of the natural and cultural environment, increasing our awareness of the need for the proper care and conservation of these unique treasures. We have a moral obligation to ensure that we preserve them for the enjoyment of future generations.

It is therefore with pleasure that I have taken the opportunity and written these few introductory paragraphs. I am sure that all those who have at heart our natural and cultural heritage will, after reading this book, have no hesitation in joining me in expressing my congratulations to the authors and the sponsors on the successful publication of such a useful reference work.

The Hon. Ninu Zammit
Minister for Agriculture and Fisheries

PREFACE

Malta (and her sister Islands) are one of the smallest among the nations of the world, but her location in the centre of the Mediterranean, the Middle Sea, has given her a unique position. The tides of ecology, culture and of war flowing back and forth have washed her shores, and impressed each upon her land. Her native plants and animals show affinities with Africa as well as Europe, and travel beyond as well as over the Middle Sea has brought further species, from the prickly pear so commonly cultivated for farm and boundary use, come here from the Americas, to the cape sorrel so common by the wayside, which hails from South Africa (Cape of Good Hope).

The central position led, in ancient times, to the prehistoric temples, and later to the imprint of cultures anxious to hold Malta as a bastion against their enemies. When not such a bastion, in unpeaceful times the raiding by pirates was distressful, and did little for heritage. Both Religious Malta and Fortress Malta have added much, however.

In recent centuries population has exploded and far outstripped the resources of the Island: except that those resources include sun and sea, and tourists can support an indigenous population far too large to feed itself, and which has never been industrial. Agriculture continues and to a surprising extent, given the small reliance on indigenous food, forms a crucial part of the land economy. Such a large population in such a small area necessarily means its impact is great, even horrific. Malta is much to be congratulated in having kept so much of her heritage, both natural and cultural. This book is written in hope and trust that it may help to conserve this heritage, now seriously under threat, for future generations. That it may help the non-scientist and non-archaeologist to under-

stand the marvellous diversity in nature and art in just one habitat of the Island, and that, understanding, they too will wish their great-grandchildren to have the same inheritance. That which, in the past was handed down without thought, now, due to the intense population pressure, needs much effort to preserve.

This book owes much to many. The volunteers and students who took so many photographs and filled in so many questionnaires are listed on the Frontispiece. Dr. Stanley Zammit, former Parliamentary Secretary for the Environment, is gratefully thanked for defraying part of the expenditure of the photographic surveys, together with the society International Tree Foundation (Malta). Mr. E. Lanfranco is thanked in particular for freely giving of his expertise. Mr. E. Zammit and Mr. F. Grima, are responsible for word processing the original manuscript.

Mrs Maryrose Vella typeset the book, and Mrs Tina Bone copyedited it. To all, our appreciation.

We are very grateful to the Hon. Ninu Zammit, Minister of Agriculture and Fisheries and Mr. Franco Serracino Inglott, Director of Agriculture. Our special thanks are due to CIHEAM Institute of Bari, Italy, whose grant paid for most of the production, and Professor Lino Briguglio of the Institute of Islands and Small States, Foundation for International Studies, who organised it. Facilities for aerial video filming and photography were provided by the Italian Military Mission, to whom our thanks are due.

Mr. J. Muscat's information on St. Paul's shipwreck chapel adds much to its interest, where expertise is clearly shown.

Permission to reproduce figures has most kindly been given by Mrs. Y. Bower, Professor Dewdney (for Bowen-Jones *et al.*), the University Library, Cambridge, The National Gallery, London, and Kilin, Malta.

S. M. Haslam
J. Borg

1

INTRODUCTION

River valleys are "a valuable national resource in terms of water resources, agriculture, wildlife, landscape, soil conservation and leisure"

Malta Structure Plan, 1990

The River Valleys

Malta is outstanding in combining small size (22 x 13 km., less than 300 sq. km. in area) with immense variety and diversity in its river valleys, which surprisingly enough, extend for 100 km. or so as major courses, and more than double that, of minor ones (Fig. 1.1). Gozo is similar, but smaller. Streams rise in deep hollows under scarps (cwms), (pronounced and from the same root as "coombes"); others slowly turn from shallow strips to ditch-like channels then to rivers; others again start in large delta-shaped depressions on flat high ground, forming channels at the downstream, run-off point of the triangle, which quickly become gorges; and there are many other patterns, too.

In their middle reaches, watercourses may run through flat or lowland farmland, deep gorges, open valleys, wide vales, and of course through towns and other settlements. Small and medium-sized channels in flatter lands have often been straightened, to help with farms or travel, but it is less easy to straighten a gorge; even here, though, wide valley floors may have modern straight (or straighter) channels within them.

At the sea, the streams may flow in over fairly flat land, the commonest pattern, but they may also run to steep cliffs, from which any water must cascade into the sea, and one of the three largest, the Ghasel system, has had most of its lower reaches ploughed over and used as fields. Truly a diverse picture.

The naming of the river valleys is fraught with difficulty. In Maltese they are "widien" (plural of wied). "Wied", though, like the N. African "*wadi*" of the same root, and with a dry climatic origin, covers the topography but not the function. A gorge or deep valley is a wied, a small

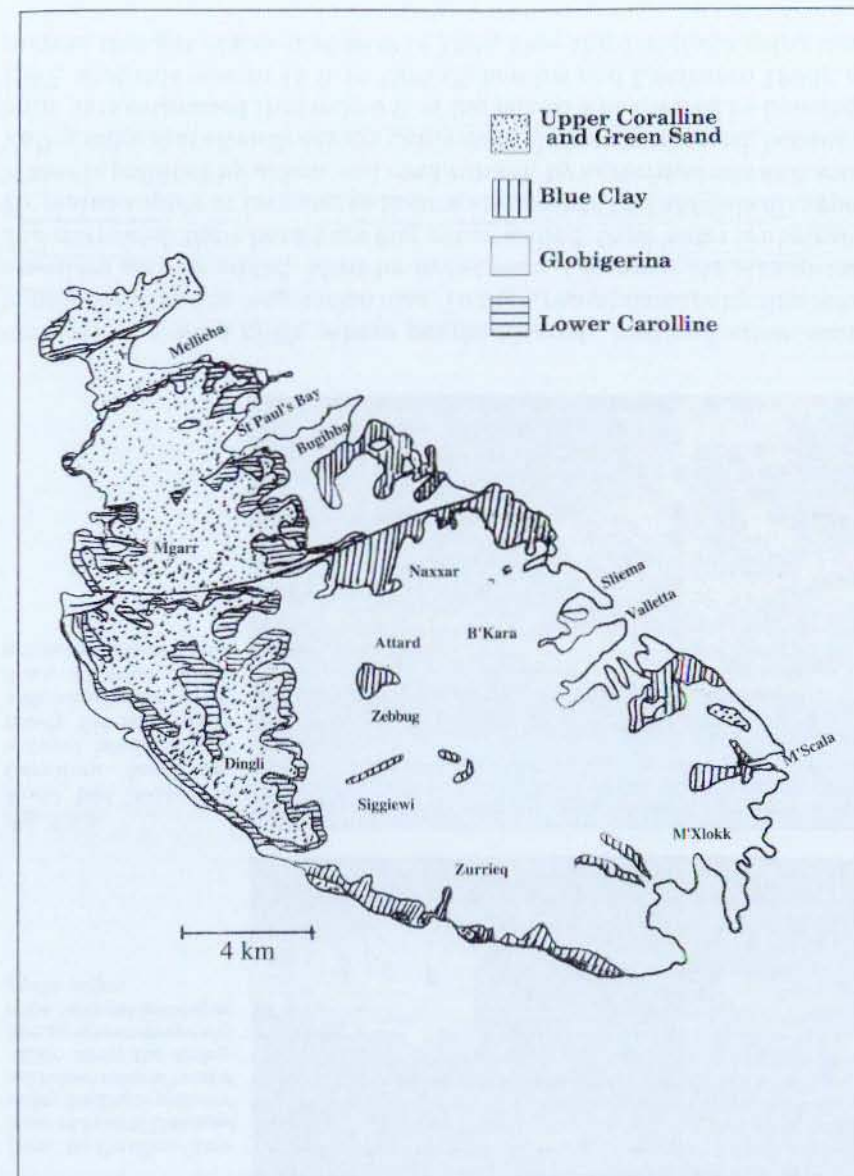
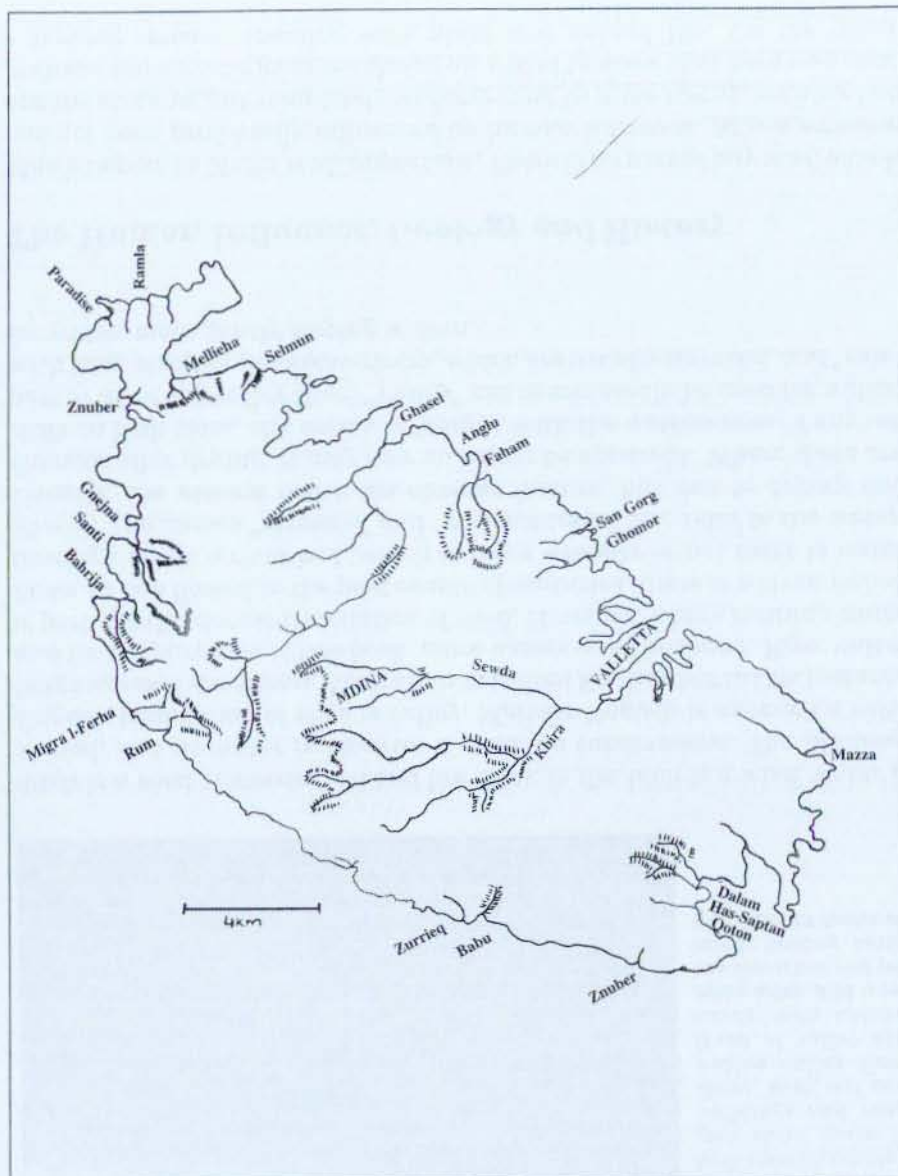


Fig. 1.1 Maps of Malta.
Above: Principal river valleys, incised wadies or associated scarps. Facing page: Rock types and towns (after Bowen-Jones *et al.*, 1961).



Fig. 1.2
Creeping urbanisation. Building on tops around valley, sides built up with rubble to give more space for buildings and roads above, worn and new-walled valley floor. Head of valley still partly with natural rocky sides, and trees, but disturbed and polluted: looking better from afar. St Andrews.

ditch is a wied, a stream bed and low bank in flat land is a wied, water is a wied, and no water is likewise a wied, no subdivisions. The Maltese-English translation of wied is valley. Maltese-English is as much a valid language as is American, Australian or Indian English but in this instance and for the purposes of this book, more names must be found. River valley is perhaps the closest translation of wied. However, where running water flows, or has flowed in the past couple of centuries, there is a river, (when flowing), above a river bed (which is there whether or not there is water above). The names "streams" and "watercourses" also refer to the water. Usually, the stream bed is an obvious feature, but due to drying and changes after drying, it may now no longer be apparent. Where there are cliffs on both sides, the wied is a "gorge", with the watercourse (if any) on part or all of the valley floor. "Valley" can conveniently be used for widien with long, steep slopes above rivers, which are usually terraced, and "vale" for wider, more gently sloping widien.

The Human Influence, Geology and History

Man's impact in Malta is all important. There is no part of any wied which has not been profoundly influenced by human activities. At one extreme are the streams put completely underground in some towns, nothing but perhaps some gratings or manholes on a road to show that here was once a flowing stream, teaming with plant and animal life. On the other

Fig. 1.3.1
Structure and vegetation of widien, river valleys (also see Figs in Chapters 4, 12, 13, etc.)

Cwm in Coralline limestone at head of U-shaped valley, leading to plain and sea below; trees at head of valley, along the spring-line; garigue on steep rocky slope, terraced farming on gentle slopes.



Fig. 1.3.2
River bed incised in Coralline limestone, natural bends, and a nearly flat floor (made with considerable water-flow). (*Dittichia viscosa*, grasses etc.). Ghar Lapsi.



extreme, are wied cliffs, where people altered bird and other animal populations, and so vegetation also. To that, recent damage by climbers or abseilers may be added. Most lie in between. Channels are straightened and narrowed, their banks are dug out or walled, their water is abstracted for mains supply or farming so their water plants and animals disappear. Water is polluted by urban and road run-off, by agrochemicals and waste. Valley sides and often floors are cultivated, slopes are terraced, houses are built. It is estimated that only 5 % of the Island was covered by housing in 1957, that this rose to 16 % in 1985 (Schembri and Lanfranco 1993), and current thought places it at 30 % in 1996. One-third of Malta going under

Fig. 1.3.3

Rocky V-shaped bed in a wide, V-shaped valley with good woody plants (habitat ungrazed, and part damp); walling and subsequent erosion give a false appearance of a watercourse separated from and incised into the valley. Wied Anglu.



Fig. 1.3.4

Straightened and dug-out small channel in a plain; banks straight, smooth; uniform, low of banks dug in deep fertile soil; flat earthen bed; no buffer strip on banks. (*Oxalis pes-caprae*, grasses and other land plants.) Wied Qannotta, Ghasel.



Fig. 1.3.5

Larger dredged channel carrying enough water to restore natural mobility; dug to be straight, but erosion is producing bends, with eroding "scarps" on concave slopes, and gently-sloping bars on convex ones; the bed is partly soil, partly flat *Globigerina* limestone, with some stones; bank and bed both show variety, unlike (4) above the wide banks form short buffer strips. Wied Hemsija or Campa, Sewda.



Fig. 1.3.6

River bed about 10 m wide, higher part to right is smooth river-worn Coralline limestone, with bank beside of uneven, lichened rock with rain-eroded surface; variety of both bed and bank; flat beside river bed; *Aster squamatus* in lower earthen bed; *Dittichia viscosa* etc. in cracks on higher rock beds. Wied is-Speranza, Ghasel.



housing! Despite the restrictions in the Malta Structure Plan, urbanisation is affecting the widien (Fig. 1.2), houses being built on the scarps above, on the wied slopes both steep and gentle (and a few are built even in watercourse beds, presumably by people who have never heard of floods (see Chapter 8)).

In the 1950s "Everything one sees in Malta, other than the major topographical features, is man-made and man-maintained in existence. For this reason there is an unstable equilibrium that eternally threatens to collapse". So wrote Bowen-Jones *et al.* (1961). Since then wealth, mobility and leisure have vastly increased. There is no longer the pressure on the farmers to use the land sustainably (that is, to

use it in such a way that throughout their lives, and those of their children and grandchildren the land will yield good produce), so walls and soil are not maintained fully and erosion bringing soil into the rivers is worse, and the results uncontrolled. Water is used as if there was no next year, let alone no next centuries. The present leasehold system of farmland does not encourage investment in there. Wealth means all this can be neglected or harmed because money will pay for replacements (of a sort!). Mobility means that houses, work places, roads and traffic are dense throughout, instead of being restricted to the ancient towns and villages. Leisure means recreational population pressure and usage impact throughout the land, including the widien.



Fig. 1.3.7
Walled river bed; new to left (note bridge with entry of wetter stream); less new to right; bend; bank habitat or buffer strip present; lower part of river bed with more water; soil and some stones (*Oxalis pes-caprae* and other land plants dominate the dry higher bed, and are patchy on higher parts of the more flooded bed). Wied Xkora, Kbir.



Fig. 1.3.8
Walled river bed with a flat soil bed, and older walls; has been straightened where this was easy; bending round scarp; such low walls are typical of Majorca; little variety; receives little water (*Oxalis pes-caprae* and other land plants). Near Hal-Far.

This all means **"The collapse foreseen is an increasing reality, the unstable equilibrium no longer being maintained"**. If this situation is allowed to continue, the extraordinarily rich and varied heritage of Malta's wieden will be lost. One of the authors has surveyed rivers in nineteen countries of two continents, (with a data base of over 35,000 sites) and, square mile for square mile, Malta even yet is above all others for features of interest, in both its natural and its historic heritage. This book is a plea for the understanding of this heritage, and its consequent preservation for future generations.

Fig. 1.3.9
Walled river bed with old and sturdy walls, and cross-wall with apertures; trees above the river bed; flat soil bed; much variety of valley, little of bed (*Dittichia viscosa* and other land plants). Wied San Niklaw.



Fig. 1.3.10
River with natural bends, at the bottom of a terraced valley; the bed position is determined by the terraces; the river bank is higher upstream; walled or with fallen walls; downstream to left there is (rain-eroded) limestone below, concrete to right (it is easier, though environmentally much worse, to pour in erodible concrete than to repair retaining walls); the dams have a central lower portion for normal flow, and a higher one for severe storm flow; upstream silted up and marshy (*Cyperus longus* dominant), downstream flooded, with Blanket weed (long filamentous algae); on banks, *Chrysanthemum coronarium*, *Festuca arundinacea*, *Hedysarum coronarium*, etc.) Some variety in bed, bank and vegetation. Wied is-Sara, Gozo.



Geology and History

The Maltese Islands (having earlier been part of the land between Europe and Africa) became islands after the latest Ice Age. People arrived here by at least 8,000 BC and the process started, the process of people changing the land to make it more suitable for their needs for food, clothes and shelter, and their wants for everything from gardens to piracy. Intensity of

Fig. 1.3.11
River-worn *Globigerina* limestone bed, showing two periods of erosion. (a) The whole bed. (b) A deeper channel within the bed; the raised road runs parallel to the bed, taking up part of the bed-space; the presence of land plants, growing even in the deeper sub-channel, indicates there is little water flow. Wied Qlejgha, Ghasel.



Fig. 1.3.12
Walled river, with a recent wall replacing the old terrace retaining wall, itself needing repair; damaging dredging determines the bed level, thus water level and vegetation; but variety of texture and biota has been lost; the bridge (far) is across a (pre-existing) field as well as the river. Wied Qlejgha, Ghasel.



Malta is lime-rich. The geological make-up is:

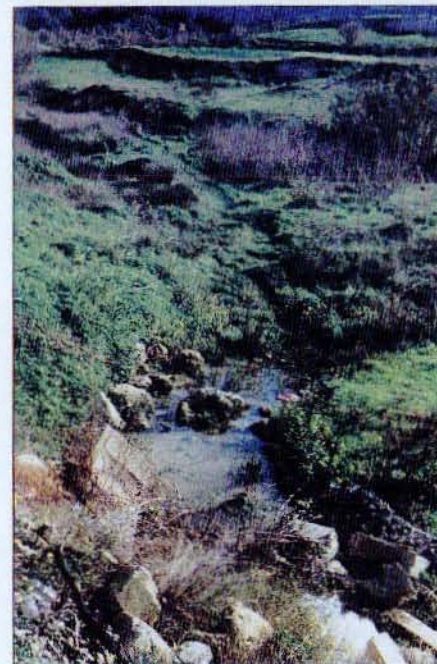
- (top) Upper Coralline limestone, up to at least 160 m thick
- Greensand, 0–15 m
- Blue clay (not always blue!), 0–70 m
- Globigerina* (a tiny animal, important here) limestone, 22–200 m
- (bottom) Lower Coralline limestone, at least 190m.

(Bowen-Jones *et al.* 1961)

Fig. 1.3.13
Variation of level, texture and disturbance causing variation in vegetation (Fig. 16.1 shows this in more detail); conifers on left, but unsatisfactory exotic eucalypts to right; good variety of bed, poor variety of bank (*Rumex conglomeratus*, *Dittichia viscosa*, grasses etc.). Wied Qlejgha, Ghasel.



Fig. 1.3.14
Variation in bed width, Gnejna Valley. (a) New bed for a very narrow stream (expanding to a small pond where dammed by fallen rubble) set in a semi-flat old bed bounded by terrace walls and 10 m or so wide; grassed fields provide a good buffer strip; *Arundo donax* patches occur along the edge; *Scirpoides holoschoenus* patches are nearer the centre of the grassy the grassy bed.



use has gone up and down, increasing with peace and hence prosperity, decreasing with war and raiders on the soil of Malta. Overall impact, the diversion of wied and land from what it would be without people, has increased over the centuries and is now far greater than ever before.

The Coralline limestones are hard, and form plateaux high and low, with garigue, caps and scarps, at the base of which, especially above the clay, springs emerge. (Rain water

percolates easily down through the limestone, collects inside, and runs out as springs where intake is greater than storage capacity). This occurs particularly when the water meets the clay, which is largely impervious to

Fig. 1.3.14 (b)

Just downstream of (a), the bed is narrowed by, at the right, the modern road, and at the left, by extending the field into the bed; so there are new walls on both sides (in contrast to (a)), unstable ruderals still dominate the bed (again in contrast to (a)) where the stream passes, but so far unmarked from above.



water movement, so water cannot continue downwards, and flows out sideways as springs. Spring lines — lots of spring — are (or were) therefore found at the base of limestone scarps. These are known as “gnien” lines, gnien being a garden or orchard, and here, where there was ample irrigation water for the dry summers were the places watered by these springs, fit for the orchards etc (with little effort needed from the farmers). The Upper Coralline is more in the south and west, where also steep Blue Clay slopes often occur under the capping of the Coralline. The Lower Coralline is more abundant in the north (Fig. 1.1). Most of the

Fig. 1.3.15

Stony river bed, narrowed to the left by road construction and with a dug edge on the right (forming narrow and over-sandy, so low-efficiency, buffer strips); partly shaded by native trees, otherwise little variety of bed or bank; Crown daisy (*Chrysanthemum coronarium*) is on the most disturbed ground. *Galactites tomentosa* (with white flowers) dominates on more stable parts; and the river bed vegetation varies in both colour and texture (and decreases in shade). Wied Marsalforn, Gozo.



Fig. 1.3.16

Small stream with high walled sides, overgrown with ivy (*Hedera helix*); fairly young deciduous trees planted within the channel, citrus beside it; otherwise little stream variation, though sediment deposition patterns can be seen at the sides, above bed level; collecting point (when flow was greater) just upstream of picture; fallen leaves in channel provide valuable organic matter (and variety); pipe across. Wied il-Luq, Kbir.

land, though, is *Globigerina* limestone, which is a soft rock, and has been eroded over the millennia into gentle lowland landscapes. It forms low ridges, and shallow plains. Finally, there are some flat drained flood (and estuarine) plains, with alluvium above the rock below.

Where “Ghajn” appears on the map, there will be (or has been) wa-



ter. Ghajn refers to springs — e.g. Ghajn Znuber (Aleppo Pine Spring) — sometimes to rivers e.g. Wied il-Ghajn Rihana (Myrtle Spring) and by an extension from these natural sources, to reservoirs, horse troughs — e.g. Ghajn Rasul (Prophet’s Spring) — fountains for supplying water, and ornamental or utility fountains in

Fig. 1.3.17

River channel descending through a rock fissure to the sea; low flow; (earlier greater flow from springs and run-off would have been largely lost by here, see Fig. 2.4); woody plants on soil on former cascade; pockets of soil on cliff bear short plants. Wied il-Migra Ferha.

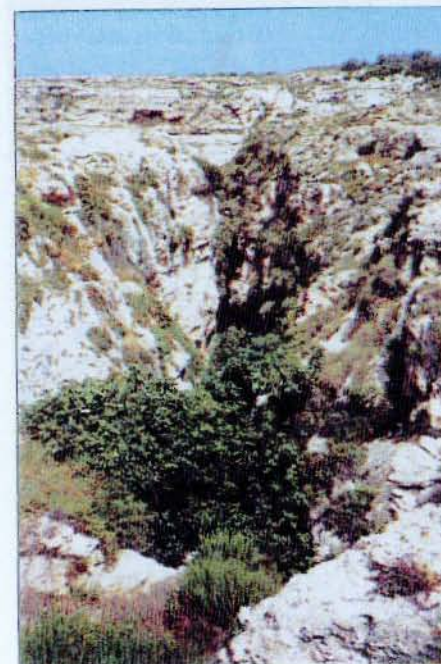




Fig. 1.3.18
Grassy river bed with a central deeper line bounded by rock outcrops to the right (giving near-vertical or gentle slopes) and by a terrace wall to the left; dam; far, a field extension narrows the channel, which otherwise winds with topography. Wied il-Ghajnsielem, Gozo.



Fig. 1.3.19
V-shaped Coralline gorge, with a dam and silted impoundment upstream, and a steep drop downstream; shrubs dominate the impoundment, the steep limestone bears garigue; the terracing increases as the slope lessens; (trees are especially found at boundaries); the river is not obvious in the plain below (see Wied il-Faham, Chapter 13); good structural variation. Wied Ingraw.

settlements – e.g. Ghajn Hasselin (Laundry-women Spring). The closest English word for ghajn is fountain, derived from ‘fontana’, Latin for spring, which has gradually transformed its meaning from the springs to the artificial and ornamental water supplies. However, except poetically and biblically, fountain is seldom now used for a spring. Ghajn still covers both types.

Otherwise place name evidence is unhelpful. Ilma is water, but is absent from place names, except for e.g. one river in Malta, Wied Ilma, and one in Gozo. Some names surely are descriptive – e.g. Wied il-Ghasel (Wied of Honey) – of a stretch with a large rocky gorge eminently suited, in the

Fig. 1.3.20
Dredged bed with negligible variation; man-made sides, with some textural variety but smooth and uniform; old structure near the ford; a buffer strip to the left, and a narrower one to the right. Wied il-Ghajn Rihana, Ghasel.



past, to many colonies of wild bees. Others, even though the meaning of the word is certain, may be of uncertain description. Was fennel (*Foeniculum vulgare*), now so abundant, really so rare that Wied Busbies, (wied of fennel), stood out as a major source of it? For yet more, the meaning is unsure. Burmarrad can be derived as the sickly place, and, with a large marsh beside, it is highly probable it was sickly. Alternatively, though, the word can be derived from a port, which was undoubtedly there in Roman times. Wied Liemu could mean the wied of reproach (numerous historical incidents could have given rise to that) or it could have come from the name of one of the first Carmelite priors of the convent just above. In contrast to Burmarrad, where either name – if validated –

Fig. 1.3.21
Natural channel filled with soil, water finding its flow path along the edge of a field in the Burmarrad plain. Wied il-Ghasel.

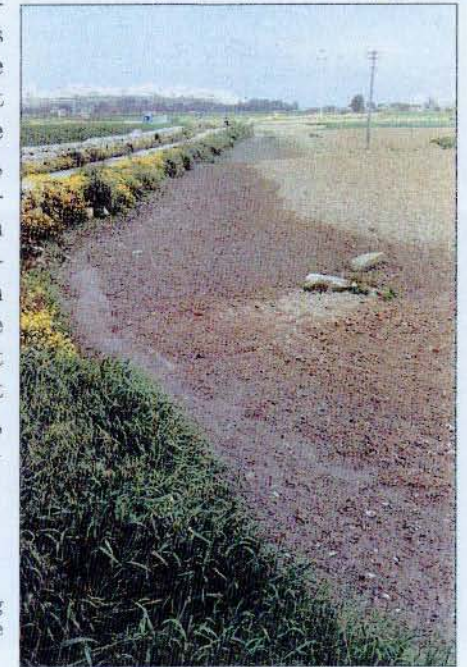




Fig. 1.3.22
Stream in a dug channel beside the road, neither channel nor road are at the basal point of the valley so presumably have been moved; present channel straight, narrow, uniform and walled (*Scirpoides holoshoenus* prominent on banks).



Fig. 1.3.23
Narrow V-shaped valley with patches of enough soil to bear *Aster squamatus*; note the rain- (not river-) eroded rock surface even close to the bed; diverse. Mistra Valley.

gives a useful water-related historic meaning, neither of those of the Liemu help. Other again are clearly just from names e.g. Wied San Niklaw, St. Nicholas, and cannot alone help in river history. Wied il-Migra Ferha (the warm welcome) applies to the valley on the south-west coast where (by tradition) Count Roger the Norman, of Sicily, landed in 1090, to invade, and to expel the Arabs, restoring Christianity as the official religion. Historical, undoubtedly, but more topographical than water-related.

When a land first rises above the sea, or the sea retreats from it, it has no rivers. There necessarily are none, under the waves. Rain falls, and rain-water must go somewhere. Some sinks down into the earth and emerges at

Fig. 1.3.24
Dredged impoundment bearing *Aster squamatus* (and *Foeniculum vulgare*, fennel etc); contrast with (23) and (18); note the structure: banks dredged or dug, gentle above, steep below, then flat; part dredged in a U-shape with the ground (so the water) level influencing the vegetation. Wied il-Kbir.

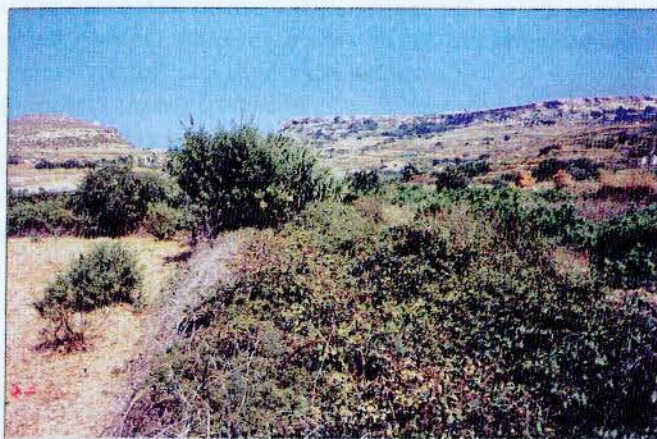


Fig. 1.3.25
Good aquatic vegetation (*Typha domingensis*, *Apium nodiflorum*, *Festuca arundinacea* etc); water clear. Wied il-Ghajj Riĥana, Ghasel.



specific (topographical, geological and hydrological) sites as springs. That which cannot sink down, runs sideways, wherever there is even a slight downward slope. The spring water flowing out of the ground also flows downwards, eventually also to the sea. With the passage of centuries and millennia the water carves out the rivers, the valleys and the gorges. The main gorges here were eroded in the past. From then until the recent drying, rivers eroded to a much lesser degree. (Fig. 1.3 (5) shows rivers are still flowing enough to erode, to carve out channels for themselves, where man's imprisoning has not been too strict). Over recent centuries, as more land could be brought under cultivation, the nuisance of the natural winter

Fig. 1.3.26
Channel covered by
brambles (*Rubus
ulmifolius*); no buffer
strip. Wied ir-Rum.



flooding of what could be farmland became greater, and rivers were increasingly walled or given steep excavated banks, to keep them within bounds as well as to act as boundaries between lands. With the recent drying, much of this walling and digging out is now unnecessary for that purpose, but now, the rivers are so narrow and the terracing is so steep, that wall and bank maintenance is necessary to prevent erosion and infilling. All the old walls are "dry walls": "dry stone walls" in English-English, "rubble walls" often in Maltese-English. "Rubble", though, is also used in for piles of stones, broken or rejects from building, dumped into valleys and a damaging nuisance. As "rubble wall" is applicable to both

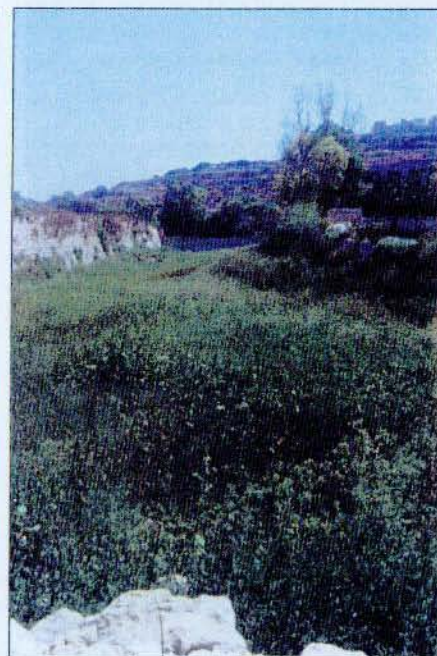


Fig. 1.3.27
Silted up impoundment dominated by *Alisma
plantago-aquatica*; uniform and man-made
habitat; diversity deplorable. Wied Qlejgha,
Ghasel.

Fig. 1.3.28
Small (ungrazed V-
shaped wied, with rock,
stone and soil; *Arundo
donax* dominates down-
stream, mixed damp
and garigue species (in-
cluding *Dittichia viscosa*
and grasses) are in the
foreground; little recent
water (except severe
storm); diverse. Migra
Ferha



Fig. 1.3.29
River bed mostly covered
with *Arundo donax*; other species in-
clude *Capparis spinosa*,
Foeniculum vulgare,
and grasses. Wied
Baqqija, Kbir.



uses of "rubble", "dry wall" is used here for the walls made of dry stone fitted together by hand (with much skill but no mortar) as opposed to just heaps of unwanted stones, or modern wet concrete or mortar walls, made of smooth blocks of stone slabs cemented or placed together.

The erosional changes in a landscape with time are a complex response to environmental change. Geology remains constant (apart from extensive quarrying, and replacement of quarried rock with landfill rubbish). Land use, vegetation and climate all vary and affect river development (Schumm *et al.* 1989). Erosion is often random, depending on the place of heavy rain storms, and the conditions of that place (the slope, the soil, the degree of

Fig. 1.3.30

River bed with much *Dittichia viscosa*, also *Atriplex hastata* etc.; with *Arundo donax* and fig (*Ficus carica*) above. Wied Baqqija, Kbir.



erosion control, the degree of saturation of the soil at the time, etc). Sediment is washed to the valley floor. Erosion is increased by narrowing the flow paths, concentrating the flow, increasing the speed of run-off (less trees, more roads, etc), steepening the gradient (straightening channels etc). Gullies may develop in valley sides, in soil and through walls etc. Such gullies are usually temporary. They may also develop as lower, narrower channels within the valley floor, e.g. Chadwick Lakes. This pattern may also be made by farmers cutting a new deeper channel on the valley floor.

Climate

The climate is, of course, Mediterranean. Temperature day maxima average from over 30° C. in August to only 15° C. in January. Sunshine hours vary from an average of 12 in high summer, to 5 in mid-winter. Relative humidity is fairly stable, usually 65 to 80 % with little seasonal variation (though in winter it is of course particularly noticeable. Rainfall averages 500 mm. most falling between October and March. The early rains of September and October tend to be very heavy but short showers, longer and lesser rains occurring later in the winter. The combination of

little rainfall and high temperature renders much of the summer months unsuitable for plant growth. Wetland plants whose rhizomes and roots extend to perennial water being one of the exceptions.

Rainfall is quite unusually variable from year to year, therefore the amount of run-off to the rivers varies greatly. A good storm flow in the Ghasel, with enough water to cascade over dams, is likely to merit a photograph in local newspapers. This now happens after heavy storms in wet years (see Chapter 2, Bowen-Jones *et al.* 1961).

Soils

Because of the limestone, soil is calcareous. It is also shallow, averaging 30 cm. In dryland soils the pH value is normally over 8, lime-rich. Organic matter is low, under 4.5 % in cultivated, over this in uncultivated soils. This would apply to slopes around the watercourses and the driest valley floors. Wetland soils have not been looked at, but their organic matter would be higher. Soil depth varies from nil on river beds directly on the solid rock, to over 2 m. in silt-clogged impoundments (Bowen-Jones *et al.* 1961).

Structure and Diversity of Wieden

The structure and vegetation of a range of wied types is shown in Fig. 1.3, which should be examined at this point, as being a crucial part of the text. The pictures should be looked at carefully, and the captions read more than once, because they provide information for understanding both river valleys and the rest of this book! Study should start with the overall topography, the size and shape of the wied. Secondly, the features of the watercourse, its placement, windings, straightenings, size and shape should be examined. Next, the pattern of the watercourse and valley floor should be noted, the influence of man on this (e.g. position, banks walled or dug, channel narrow, channel excavated, dams, bridges, fields on valley floor), and the overall vegetation type: aquatic, wetland, dry land, and if dry land, tree, shrub or herb (short plants). Fourthly, the pattern on the slopes above (where present) should be looked at for land use, terracing, farm crops, trees and shrubs and the pattern of each, followed by roads, houses and other urbanisation. All features in the captions should be identified in

the pictures, (plant names are the latin ones of the most prominent species. See species list at the back of the book).

Fig. 1.3 shows variety, and that the variety in Malta is marvellous! Diversity is also important within wieden and variety in river bed architecture, river bank architecture, vegetation architecture and, where relevant, of the slopes above, should be checked. All are important, all add to the conservation value, the heritage value, of the wied. River valleys are not uniform environments, they have many distinct habitats bearing distinctive communities. It is people that impose uniformity, at the worst we have the uniformity of the completely concreted river valley section.

Finally, man's impact in these pictures can be re-examined. Outside the main topographical features (gorge, lowland), how much is not due to land use, constructions, maintenance or its neglect?

Population Pressure

In the Maltese Islands the land use has been exceptionally heavy, because of the small size and, over recent years, high population. Estimates for the Islands (Bower-Jones *et al.* 1961, Haslam, 1997, Times of Malta) :

1240	5,600	1956	316,000
1565	25,000	1961	330,000
1798	114,000	1991	340,000
1842	114,000	1996	376,000

This is about 0.01 sq. km. per inhabitant, since World War II. It is hardly surprising that population pressure is so great. Farming formed the greatest earlier impact, but now water loss, recreation, waste disposal and urbanisation are also very important. It is striking that so much good remains.

The Status of the Wieden

The wieden form the wild-land corridors (Greenways in USA). They cross the country from side to side with space and habitat for animals and plants. Both water and land species (of appropriate habitat) can move along the wieden, when they may find crossing to another one, difficult. No other

route offers so much of a reservoir and a highway, certainly not roads. The wieden are excellent for the preservation of biodiversity (as agreed in the Rio Convention). Unfortunately many have recently been fragmented (by construction, drying, disturbance, pollution, dumping etc), and this fragmentation is rapidly increasing. Small separated bits of wied habitat lose much of their Greenway advantages (Haslam 1997b).

Water plants and animals are threatened in Malta, with all the recent drying; disproportionately threatened compared to land ones (see Chapter 3). The wieden are valuable for endangered as well as common species. When considering disturbed and dried areas, restoration is not a possible choice. Neither restoration to a pre-human impact state — which is quite unknown — nor a traditional and sustainable managed state as found from the, say, early nineteenth to mid-twentieth century (when the main change was progressive loss of water and improvement of farming.) If it is possible, the best that can be done is to enhance the present to become as like the traditional wied, in as many respects as practicable: to enhance, and to save, to return the system to a close approximation of the pre-recent disturbance ecosystem, to a state which can persist and be self-sustaining.

The natural state of rivers is one of dynamic equilibrium with features such as banks, bend structures, gullies, pools and shallow places coming, changing and going, and bends and large-scale patterns changing over a longer time-scale. This is the dynamic equilibrium, a state of change, but of changeless change, a boulder here going, one there coming. On this pattern man superimposes, and restricts the natural change. In Malta this was done earlier by restricting the river water that causes the change. Changes still happen (see Fig. 1.3, and Chapter 8, Floods) but so very much less than before, that people forget they may happen. This is a grave mistake. Like electricity, rivers are most valuable, but also can injure and kill. They are valuable both in their own right, as features, habitats, sources of plants and animals, and for their use to man, for example for water supply.

States that have not established a water right for instream uses should do so (Mourizi and Pöilon, 1992). Water, aquatic plants and animals, should all have protection both by law, and by the opinion of the people.

2

RIVERS OR VALLEYS?

If you wish to converse with me, define your terms
Voltaire

Malta has no Rivers ?

"But Malta has no rivers". How often have the authors heard that said? Too many times to count! It appears to be a generally held view. What about its truth?

Fig. 2.1 would pass in most countries as a picture of a river, but the local newspapers tend to term similar views as being valleys looking like rivers. Valleys, necessarily, are cut out and formed by rivers. That is agreed. The amount of water now flowing in the valleys could not have formed them. That, also, is agreed. Climate, however, can change but still leave rivers.

Figs. 2.2 and 2.3 illustrate foreign rivers. Fig. 2.2 is of a river in a valley. This valley was not and — in post-Ice Age time — could not have made by the river. While these are different to Malta, the widien are not different in kind, only in degree. Fig. 2.3 has a strong resemblance to Malta! It shows a stream usually flowing all year in a drought year when it has dried up. Yet this is still a stream, and a stream bed. For how much of the year must streams be dry before "England has no rivers"?

Fig. 9.2 should be examined at this stage. Here, in the mid-nineteenth century there was ample flowing water in the River Ghasel. The present river-worn channel Fig. 9.2 (d) shows this past flow (though not, its date). The 1882 painting of Chadwick Lakes (also in the River Ghasel) by Girolamo Gianni shows water completely filling the valley, so much so that a carriage is passing not on the valley floor, as now, but on its top, outside.

Floods reached this high level after the 1979 floods and for a few hours in the wet winter of 1995-6. the Gianni picture shows longer-lasting, high water, of a height few now could believe would ever occur.

The dams of the Chadwick Lakes were sited at nick-points on the long

River or Valleys?

Fig. 2.1
River running with rain-water (plus a very little spring water), Ghasel; water turbid with top soil (mainly silt) from farm-land, river bank, its protection, and the dam.



profile (i.e. where there was a sudden steep slope going downstream) and where these had springs. Mr Chadwick's own report (Chadwick 1889) described the uppermost impoundment as supplying a 22cm earthenware pipe from (all) the springs (when only one dam was made) which was too small for the summer supply of mains water for towns. A mains line was therefore proposed.

In winter, the extra water largely goes for storage. The normal winter flow in what is now Chadwick Lakes was 40 million gallons, hence a proposal for a large reservoir, for agricultural water and for extra dams to collect 10 million gallons: the Chadwick Lakes themselves. Similar "Lakes" could also have been at San Blas, with a spring water from the Luq, Girgenti and Isqof (River Kbir system).

Galleries mined just under the

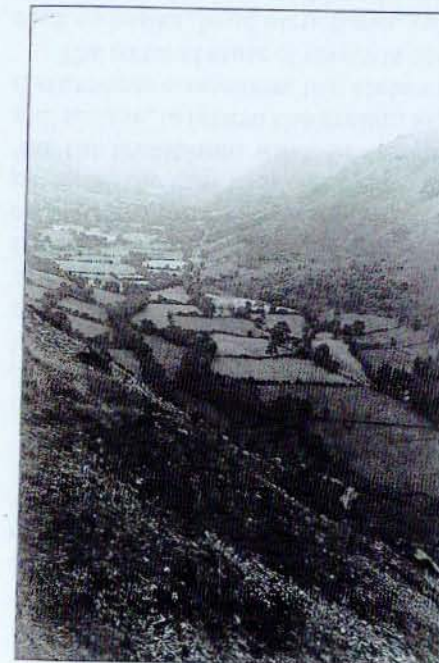


Fig. 2.2
River in valley, formed by ice, not by river, Wales.

Fig. 2.3
River (upper) dry in a dry summer, England.

surface of the Sewda and Kbir widien were full of water, yielding 100 gallons per day per foot of gallery. This illustrates the "saturated sponge" nature of the *Globigerina* limestone in the 1890s: alas, now so much dried.

Fig. 11.3 of the upper Gircanti is also conclusive for recent loss of river water. Here is a Knights water channel (of the Grand Inquisitor's Palace system). A little upstream, this channel started, on the valley floor. Then it ran (at a lesser slope than the river bed itself) along the side of the channel, until forking off further down. A comparable new channel is shown in Fig. 15.2 (e), which is collecting rain run-off and conveying it to a water storage tank. The difference is that this channel is at the bottom of a V-depression, catching the rain from an expanse of hill, while the Gircanti stream was largely spring fed, and the channel is flat on the valley floor, which therefore was all covered with water. There is a bridge downstream on the photograph, where now no bridge at all is necessary over the dry bed. The bridge is now destroyed, and the road crosses without a bridge. This gnien area has numerous perennial springs: why go to all the trouble of building a long water channel unless water flowed in it for many months of the year?

The same occurs in the Luq, at Buskett (though rather less easily seen, as there are so many other structures present also). Here the channel starting on the river bed can still be seen, diverting some of the water for Palace use. Again, unless there had been much water for many months of the year, why build the channel? There were plenty of springs around as water sources: this must have been an easier, not a less possible option.

Indubitable evidence that two of the major river valley systems were



ivers in the recent past is therefore available. For the third, the Sewda wided system, there is the 1890 picture by G. Gianni, showing a (by then, mainly or entirely ex-) waste channel running down the hill from Mdina. (Whether it flowed direct to the Wied il-Hemsija, or via the spring-fed pond in the clay above the stream, is not clear.) The waste went to the river for downstream removal. Mdina was too large for a continuing pile of waste to be acceptable for public health (and no disposal fires show in the picture).

What about direct records of water? The Arabs moved in from fertile Sicily, where they could find all they wanted. They had a culture requiring ample recreational water (drinking water is always the priority, recreational supply comes after). Arabs had gardens with fountains, tinkling water and pools. They grew many citrus trees in Malta, a fruit needing a plentiful supply of water. Water was obviously ample: if not, why bother to do anything in Malta? Sicily provided a good living, N. Africa was Arab. The Maltese could not effectively fight both, so security would be achieved with only a small Arab garrison.

Nine centuries later, when the Knights of St. John of Jerusalem were about to be pushed out of Rhodes, they reported on Malta, in 1524. Clearly they did not want to come here, as they were scathing about the people (poor and miserable), the soil (barren), and the supply of wood (fuel mostly thistles and dung). Why come? How could they survive? Only if the water was, despite their criticism, basically good and with technical development and peace to pursue it, prosperity could follow. Because we now turn a tap and do not look out of the window, it is easy to forget the necessity of surface water in the past.

Evidence from Floras

In 1853 Grech Delicata, in the *Flora Melitensis*, recorded plants as growing in small rivers *rivulis*, slow-flowing waters i.e. rivers, not standing waters *aquas lento fluentes*, common standing waters (in marshes, perhaps spring pools etc) *stagnis vulgaris*, places flooded most of the year *inundates*, watery places *aquosis*, marshes *uliginosus* and damp places *udis*. Added to these are distributions in large ditches *fossa* and damp furrows or ditches *vallibus humentibus*, and river banks *ripos rivulorum* (also see Chapter 3).

This is an extensive list of wet and wetland places, ten distinctive and separable habitats (and this before large dams had introduced their own habitat variability). It is quite clear Malta was then wet! The Marsa

marsh, a very large aquatic habitat, was extant (main drainage started in 1861) and other smaller coastal marsh drainages followed later (e.g. Ghajn Tuffieha).

In 1927, Borg, in the *Descriptive Flora of the Maltese Islands*, describes a considerably drier land. He refers to streamlets, streams and water-courses, frequent pools in valleys, slow-flowing waters, fresh standing waters, moist valleys, places with some dripping of water, moist places and irrigation channels. He also noticed Malta drying, during his working life, perennial water plants gradually disappearing as spring water was increasingly diverted from the valleys to the fields. Borg describes low-lying land which is inadequately drained and land with stagnant moisture.

This intermediate state is followed by the comments for the 1950s by Bowen Jones *et al.* (1961), and for the 1960s by Haslam *et al.* (1977), of perennially damp and marshy grounds in some widien, and water for up to seven months. Searching the widien in summer for damp ground and water does, in the early 1990s, produce some result: a pond in Wied Has-Saptan, some tiny springs in impoundments in the Chadwick Lakes and a few similar. In addition there are the rare and very special widien with a (usually) year-round trickle of water, as in the Bahrija valley. The winter position is better, but there are plenty of widien which carry negligible storm flow even in average winters (unless in the centre of a heavy storm), though the major areas do have more than enough water to fill the main dams(!), a sad deterioration from the past. The remains of marshes are even less. There is some reed (*Phragmites australis*) in the fields just inland of Salini. What a come down from the time of Grech Delicata!

Evidence from Cassar's Medical History of Malta

The eighteenth and early nineteenth-century descriptions show much marsh and standing waters, even in summer. This was an obvious health hazard. Early drainage was for farming, so varied with the wish and wealth of the landowner. Gradually sickness was noticed. An 1830s' law required land drainage by landowners, and this dried the inland marshes. Coastal drainage followed, Marsa in the 1860s, smaller ones even later.

There were repeated nineteenth-century prohibitions from irrigating vegetables in the upper Sewda valley, behind Mdina, particularly after June: so there was ample water there! Drainage was (slowly) carried out, to give dry land and free-flowing water, so improving public health. Zejtun

and Zabbar had (unhealthy) collections of stagnant waters in 1802. The Pwales valley, drained earlier, was very wet again in 1821. There was much stagnant water from Pieta to Msida, because of sea deposits.

Evidence from Folklore

There is not much, but what there is, is in favour of earlier wetness, e.g. the proverbs from Aquilina, (1972):

Do not stir stagnant water, for it will stink.

Do not stir mud.

Do not get near turbid water.

Splash along, gander, since you have found water.

It seems unlikely such proverbs arose unless water — stagnant, turbid etc (not flowing) — was a common sight to country folk. Good supplies of water were usually wanted for geese. That this water was not everywhere (not, of course, on garigue lands, on slopes without springs, etc) is shown by:

Where there is greenery, you will find water.

A riddle referring to a water wheel (i.e. a wheel turned by running water, used to power some machinery, most probably in Malta to grind corn or lift irrigation water) suggests at least one — and possibly dozens — of water wheels were on the island.

Other Evidence from River Beds

Other evidence of water loss can be seen in the water-worn river beds (e.g. Fig. 1.3 (6) now far too dry for river waters to wear the stone like this. This is common in all the major widien, especially the Ghasel system. It is not just that the floor is river-worn, but (where rock sides permit their development) there is a clear water level mark on the sides; the river had a "normal" water level flow which was stable enough to wear away the rock to a specific level. The depth was not continually fluctuating, though flow was presumably dropping or even (away from springs) ceasing in late summer. Then there are the beds, much wider than is needed by the

present flow, even where there is a good spring flow. The Gnejna valley shows this well (Appendix 2). Where the road to the coast first reaches the valley floor, upstream there is a tiny trickle (barely 0.5 m wide) in a wide grassy bed. This wide bed was left by those terracing. It was not cultivatable, it bore water.

Dams in parts of the main river systems do collect water. But who now would build expensive, large and well constructed dams in remarkably dry places like the Selmun valley, the upper Mistra valley (Mizieb) and the Gozitan Ghajnsielem? Yet those building them were not fools. There must have been enough water — in the past century — to justify all this expenditure of money and effort. There was not necessarily water in them every year, but in enough years (or in enough past years) for those concerned not to realise the rivers were now drier. (Or, regrettably, people could have been fiddling money from the Government. In all times and places this has been known.)

The ancient bridges now spanning water which is absent or easy to walk through on foot, let alone on horseback, show quite clearly that water used to be too deep for such easy crossing. (Only with motor traffic do bridges span dry gorges or depressions (see Chapter 6).) Again, there are the protections from river erosion in the wied beds that would never be done nowadays. Good examples include the pump house building on the Sewda in Fig. 2.5.

The underground galleries mined under the Chadwick Water Supply Schemes, were full of water (yielding 100 gallons per day per foot — 30 cm — of gallery.) These were in places (e.g. Wied is-Sewda) only just below ground level. No wonder that even when there were no springs in river beds, water did not sink down when ground water was all year virtually at ground level.

River water would first have been used for riverside farming. Since early settlements were sparse, and more on spring areas than beside rivers, river irrigation would have been less than spring irrigation. As farming pressure increased, so did the use of river water. The creation of Chadwick Lakes were the first major works. These were followed by many more dams and impoundments, and by more effective means of removing and distributing the water, such as electric and fuel-driven pumps, and removal by bowsers. Consequently river water demand, and its use, increased.

This century, those noting and recording river water have noticed and recorded the drying during their lifetimes are numerous, including, Borg

(1927), S. Busuttil noting that the water at the Siggiewi Road Bridge over the Kbir used to be enough to bathe in during the driest part of the year (September), and now is inadequate for this in midwinter (with average rainfall) and P. Abela observing loss of flowing water near Dingli. The losses, though seen by many, have not been extrapolated back: drying during one's own time suggests drying in earlier times also, so a degradation from a much wetter land. This extrapolation, though, is obvious when the evidence is considered as a whole.

Other evidence of water loss turns up whenever it is sought. For instance, when, in 1994 the ground by the Msida wash place was excavated for the foundations of apartment blocks, there, 1 m or so below the wash place level, is still the spring: water lost to the wash place, but not gone altogether. This was brackish water, used not just for laundry but for washing fish, with the salt acting as a (partial) preservative. The sea came up to Menqa a century ago. From 1938, drainage and drying were added to by infilling, so the coastline moved further seawards.

It would seem that, from the mid-nineteenth to the late twentieth century there has been a drastic loss of surface water in the Islands. From being a (partly) wet land, Malta has become a dry one. River valleys, from having (in many, not all) ample water for all or part of the year, now have dryness as so much an obvious character that "Malta has no rivers".

Malta is not alone in this. Other Mediterranean as well as indeed African countries have also dried (e.g. Sicily). Desertification is spreading in the region and is taken seriously by the Food and Agriculture Organisation (FAO) of the United Nations.

Use of Water

What has happened? Man's usage of water has increased. That is easier to explain than the pride in having dried up the wieden. After all, surface water is good for plant and animal habitat and biodiversity, it is good for Outstanding Natural Beauty, it is good for recreation, and of course is important as supplying an obvious source of water for farming, domestic or industrial use. It is also what used to be there, so is an integral and important part of heritage. If a country kills off all its elephants, that may be mentioned, but hardly with pride. Flowing rivers are of far more intrinsic and human importance than elephants — why be proud of having killed them? Malta is not unique in devastating its rivers. Lowland

Majorca is even worse (though the mountainous part is all right), and even lowland England, with its greater rainfall and lower temperatures, is heading the same way, to give but two examples. Whatever country does it, it is shocking, despicable, and shows the absence of a long-term vision for water resources.

Consequently this book uses the term "rivers" wherever it can be used.

Man's consumption of water has increased. Firstly, population has increased, passing the 300,000 mark earlier this century (see Chapter 1). The more people, the more water is needed for drinking, washing and cooking. Secondly, individual use has increased. The amount of water used when it all has to be carried from a village well or fountain is vastly less than when it comes from turning a tap; and baths, W.C.s, washing machines, dishwashers, etc., can all be afforded. In Cambridge, England, the average water use per person per year is put at about 150 litres or 33 gallons a day. Another about 10 % is added for use each day by people at work. In hotter places, like Florida (with more bathing, pools, garden watering etc.) this rises to 250 litres or 55 gallons a day. Added to this is the direct industrial use, for industrial processes. Malta's consumption is now estimated at 33 million gallons a day in summer (*Times of Malta*). Only 40 % comes from natural resources, 60 % from reverse osmosis plants. Added to that is the unmetered water taken for farming, from bore holes, reservoirs, dammed valleys and from the St Antnin sewage plant. Some of the farming water returns to the water table and so does a little mains water, via this plant (though, as both are polluted, this is not necessarily desirable, see Chapter 7). Domestic water used to go, via sewers, to the sea. It is now going increasingly to sewage treatment works and should all do so before the year 2000.

Added to this loss, is the large amount of run-off rain water which now travels to the sea via roads instead of via widien. Moreover the coastal road networks are designed for fast draining into the sea.

Finally, wetland drainage has removed much surface water in inland as well as coastal plains. The inland ex-marshes can now be picked out as farmed depressions. They include the delta-shaped areas often found draining into present rivers (e.g. Girgenti, Gnejna, Selmun.) Their loss decreased water resources but increased both public health and productive farmland.

Is it any wonder that the rivers have lost so much of their water? Water cannot be in two places at once. If in the tap, then not in the river. It used to be thought that abstracting from underground aquifers was safe, that this

was an inexhaustible and renewable supply, which had no effect on surface waters. This myth — which ought to have been known as such from the start — was exploded long ago. Taking small amounts, as always, makes no noticeable difference. As soon as the abstraction is of a significant proportion of the whole, significant amounts of water are diverted from their original part in the water balance of the land, and something goes short.

Surface water suffers, doubly, as it is polluted as well as being diminished (Chapter 7).

Naming the Waters

The main rivers (widien) and some minor ones are shown in Fig. 1.1 and Fig. 2.4, the latter giving names. The Maltese name (as discussed in Chapter 1) is wied, for the whole system, but naming (as in Wadi) the land rather than the water. The widien are given different names along their lengths, anything up to 5 names in 5 miles! This, though fascinating and remarkable for heritage, is of course awkward for general reference, so this book refers to, for the main three, the Ghasel, Kbir and Sewda river systems, using the name of the specific part, e.g. Qlejgha, Hemsija, only where strictly relevant. Tributaries are referred to by name, e.g. Luq, Busbies. (As usual, once the wied has been identified as such, as in Fig. 2.1, as Wied is-Sewda, Wied il-Ghasel, Wied Babu, etc., it is referred to, for brevity, as the Sewda, Ghasel, or Babu.)

Further north than Malta it is specifically and only the water which is named. An Italian torrente is the water, and only by extension, the bed, and similarly for a British river or German Au. Also one river has one name, from source to sea, though incoming tributaries have their own names. This is so in the well-mapped countries, though earlier, many names could, as in Malta now, have been used. Majorca stands between Malta and the continent in having its torrente (even when now as dry as, say, the Babu), but with several names along the length.

Rain Water and Spring Water

River water comes from springs and from the rain. (Rain water partly runs off the land to the river, and partly sinks into the land and replenishes the springs.) In a limestone country like Malta, springs were numerous. Rivers can never be without rain, nor, in Malta, are there any known to have had

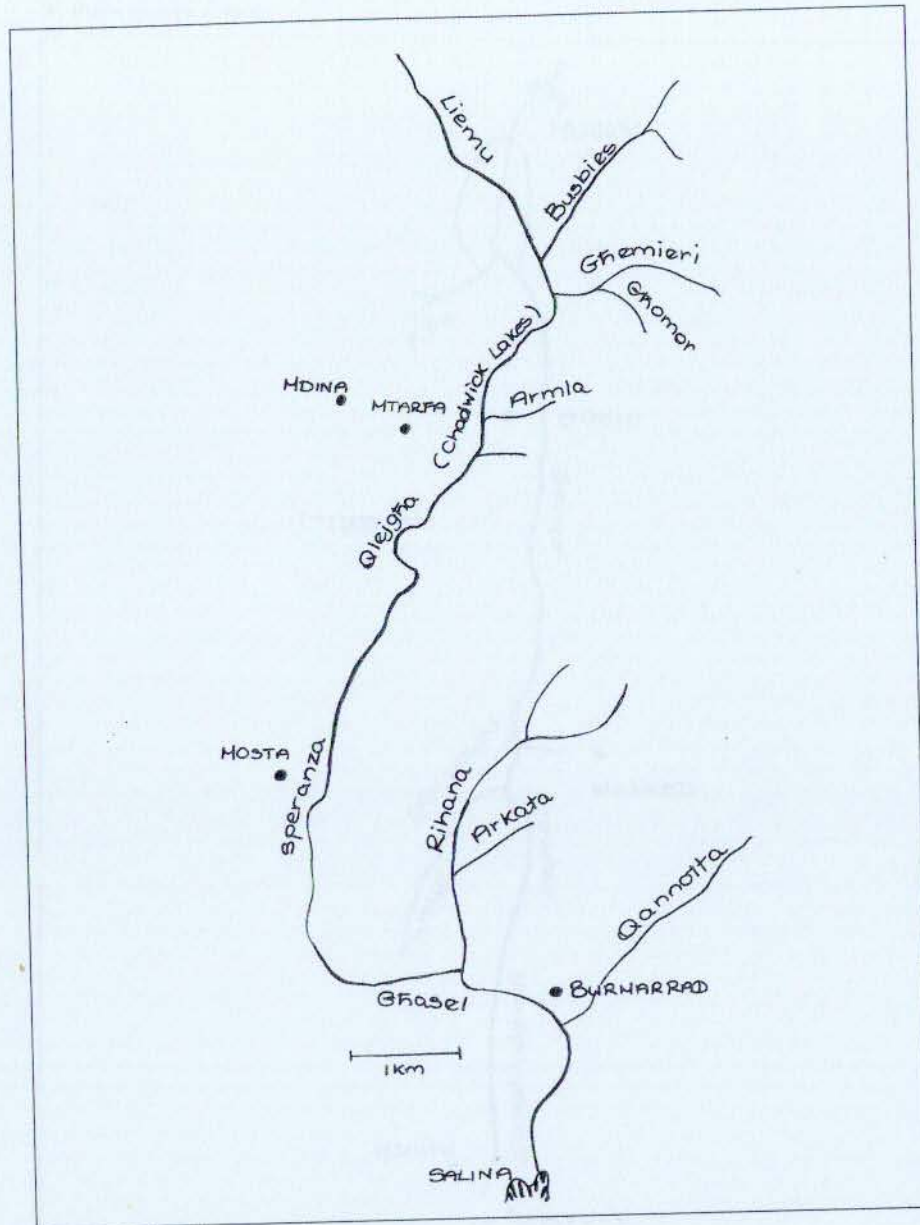
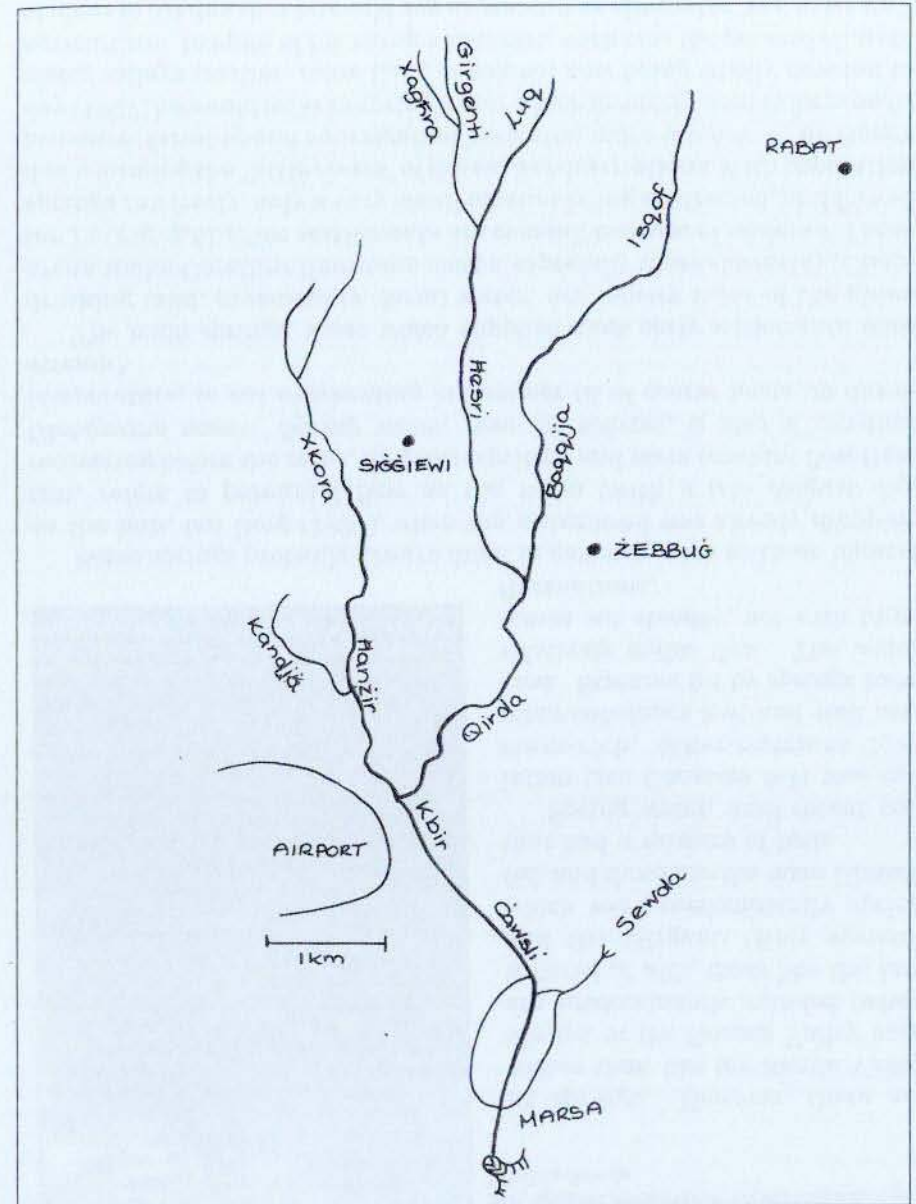
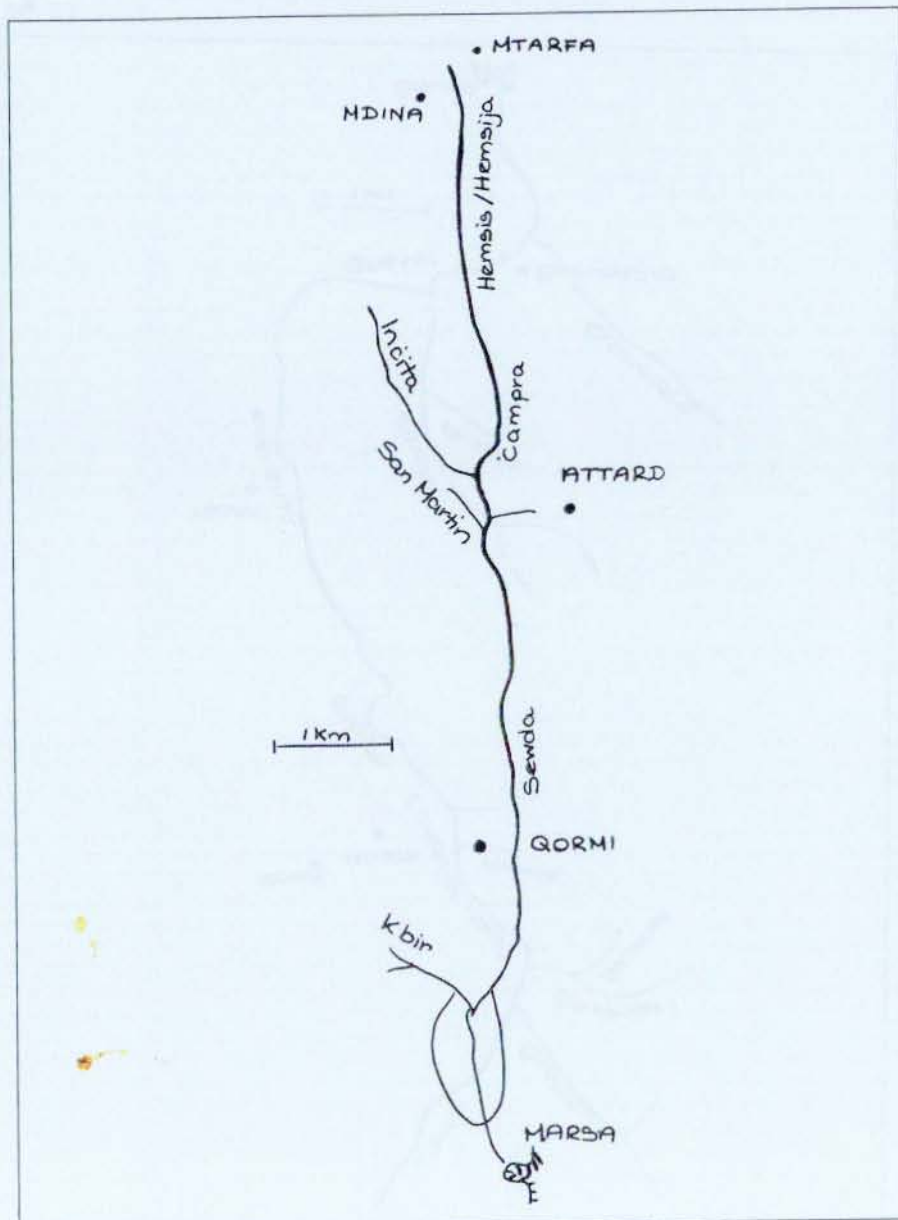


Fig. 2.4
River maps. (a) River Ghasel system.



(b) River Kbir system.



(c) River Sewda system.



Fig. 2.5
Protection of pump house protruding into river bed, against force of flow; access steps to right. Wied is-Sewda

no springs. However, there are widen that, like the Ramla Valley always, or the Selmun Valley now, are predominantly rain-fed (when watered at all!), those like the Luq and the Girgenti (Kbir system) which were predominantly spring fed, and those like the main Ghasel, that had a mixture of both.

Spring water, until recent pollution (see Chapters 5-7) was calcium-rich, other-nutrient low, other-substance low, and well aerated. Streams fed by springs have relatively stable flow. The water comes out steadily, not with large fluctuations.

Some springs probably always dried in summer, such as those highest on the hills, but Borg (1927), when the water level was already dropping fast, refers to perennial flow as the norm (with a late August dip, recovering before the rains, for gnien springs, and more constant flow from *Globigerina* ones). Spring water, near its sources, is also of constant temperature, so not overheating in summer (it of course heats up downstream).

The main springs, those which supplied most early settlements with drinking (and, presumably, farm) water, are mostly those of the gnien areas, under Coralline limestone scarps, especially those above clay (Chapter 1); (Fig. 2.6). (Few settlements are coastal, because of raiders.) These springs ran freely, only a very small amount being abstracted, and flowed down forming the "little rivers" of the earlier descriptions. With population pressure, farming and so irrigation becoming more intense — by Borg's day (1927) he would refer to spring water which formerly went to form pools along valleys (earlier, more flow, of course) now being wholly devoted to agriculture. In spite of his being a botanist, such was the general climate of ideas in his day that he could say no water was allowed to "run to waste".



Fig. 2.6
Springs (a - c, Haslam 1991).

(a) Left. Under Coralline limestone cap - gnien area where less exposed and steep



(b) Top. Shut away for private use; as is common.

(c) Left. Minor spring far downstream in impoundment, wet in August.



To waste! To fulfil its function in the water resources, water balance and natural heritage of the Islands!

The gnien springs of the upper water table are replenished by, and so depend on, the current year's rainfall, and water may be short in drought. The lower water table was much larger, and supply depended on an average of many years' rainfall, so its spring supply was more reliable. Rain run-off water fluctuates with the rain, absent in most of summer, coming up in jerks in autumn with the rain, and decreasing in spring.

Table 2.1

Average monthly rainfall (mm) (Bowen Jones *et al.* 1961)

Sep	31	Jan	91	May	12
Oct	103	Feb	54	Jun	2
Nov	68	Mar	42	Jul	5
Dec	78	Apr	22	Aug	7

The first rains wet the soil below. Subsequently rain also raises the water level. With substantial rain expected certainly in March, perhaps in April, rain-fed water could still be running for at least a month after this

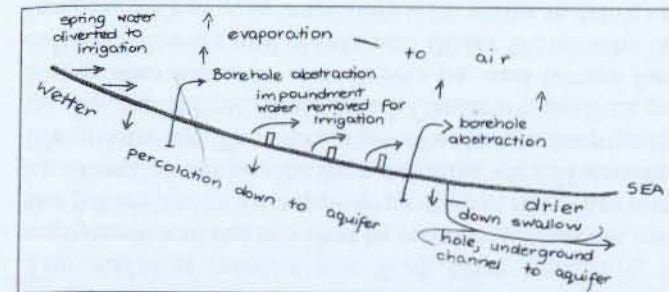


Fig. 2.7

Downstream loss of water, diagrammatic.

months of the year, on the major rivers with large catchments. Smaller ones would, of course, have less. Within the wet season, the heavy rainstorms ensure intermittently high flows. Chemically (again until

recent pollution) the water was much richer in nutrients than spring water, collecting these as the run-off passed over the land, picking up both solutes and sediments. The sediment deposition on the beds is therefore much greater than from spring water. The run-off water also has no buffering against the weather, its temperatures varying with outside temperatures.

These two water types thus form very different aquatic habitats, so bear separate plant and animal communities, as is indicated by Grech Delicata (1853), and known from present river patterns outside Malta. Mixed water type streams starting with many springs, and

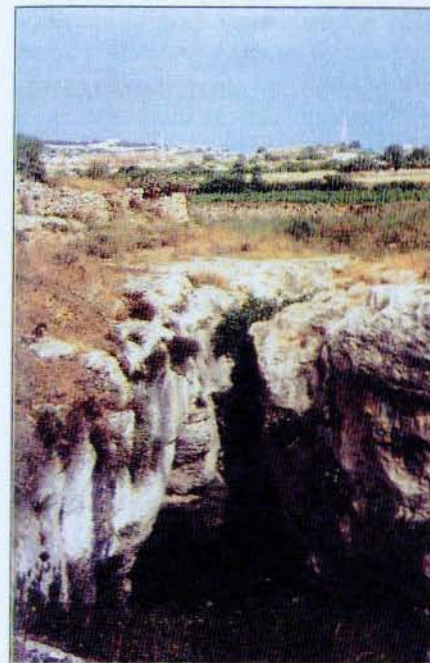


Fig. 2.8

Swallow-hole (also see Fig. 11.1).

acquiring much run-off downstream, are of course a common pattern.

Although many widien have evidence (e.g. river-worn river beds) of recent water, other, even large ones, do not, e.g. much of Wied Xkora (Kbir system). Also, even bearing in mind the water caught

in impoundments, the amount of water in downstream reaches tends to be less than that in the best watered parts (e.g. the Ghasel, Kbir and Bahrija). In summer, there may have been a good upstream, and indeed mid-stream, flow from springs, while downstream there was little or none. In winter, rain-fed run-off was more evenly distributed, and added to the spring flow. Fig. 2.7 shows the downstream losses of water, considerable even before Man much increased them: loss through the easily-percolated limestone beds, loss through evaporation, and loss through swallow holes (Fig. 2.8). It is common in limestone, for the water (which so easily dissolves the rock) to create holes downwards. River water then runs down into these, so is diverted underground, emerging further downstream or going to the aquifer. Fig. 2.9 shows the typical pattern of spring water inflow, probably what happened earlier. (Little springs still occur well down the Ghasel in the Chadwick Lakes, water coming up into impoundments — which were sited for this — even in summer.)

To conclude: But Malta has no rivers?

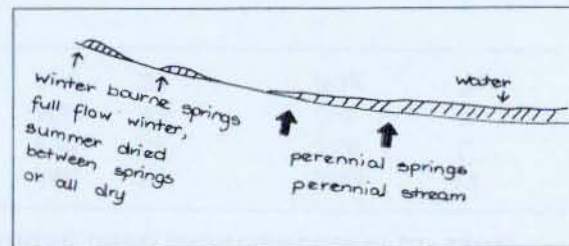


Fig. 2.9

"Winterbourne" spring pattern, diagrammatic. Top springs formerly flowing intermittently, but, due to drying, now doing so very rarely. Middle springs formerly perennial, now intermittent. Lower springs perennial, but all springs with less discharge than before.

3

PLANTS AND ANIMALS

All (plants and animals) are part of nature and hence part of the common heritage of mankind, both living and yet to be born.

1990 Draft Bill on Environmental Protection.

By virtue of the shelter provided by their sides and their water supply, widien (river valleys) are one of the richest habitats on the Island.

Schembri & Lanfranco 1993

Introduction

Nature is very important to most people in a way quite apart from its economic use. Pre-literate folk (who are likely to behave more as is natural to mankind than the educated) have many times been found to have immense knowledge of natural lore, much beyond their natural needs (e.g. fourteenth-century peasants in the Pyrenees). Among the literate, giving material reasons for conservation is usually to disguise much deeper, but less closely thought-out feelings.

In nature conservation, the unquantifiable element is overwhelming. The material reasons are: food, fibre, medicine, commercial forms of enjoyment and the fact that by conserving species, options remain open for the future (today's disappearing species may cure tomorrow's illness, or be an essential component for a satellite, etc). Moreover, many see nature as life-enhancing. The moral view of nature is deep (as the religious view may be also: see St Francis of Assisi's Canticle of the Sun, praising Sister Mother Earth who sustains and directs us, and brings forth varied fruits and coloured flowers and plants and Sister Water who is so precious. Not the language of one concerned only with water to drink and fruit to eat). When social surveys have been done in Britain, they show the deep and widespread values felt in nature.

The idea that it is duty to care for resources for the nation's descendants

was first stated by the famous Jeremy Bentham (1748–1832). The moral duty, indeed moral imperative, of conserving plants and animals has become ever more clearly recognised as population pressures and consequent habitat destruction proceed (Based on Warren & Goldsmith 1983).

Malta feels rather less of this moral imperative than many other countries, because of its unusual social history. Until very recently most Maltese lived in towns and hardly ever left towns, and this included most of the literate population, whose culture has dominated over that of the smaller rural, largely illiterate population (many of whom emigrated anyway). The latter may have been highly knowledgeable, and cared much for their plants and animals. In these days of spread population, mobility and recreation, Malta is just beginning to discover the beauty of nature. Recently there has been, in Malta as elsewhere, a blind drive to destroy nature, through higher food production and greater demands for water and recreation.

No collecting! At this stage in the degradation of Malta: **No animals, no whole plants, no flowers, seeds or fruits should be collected** except as part of a planned management programme (see Appendix 1). Where any plant species is abundant in a place, a leaf may be picked by a group or a person, for identification or study. Otherwise identification can normally be done on site with the Flora etc, and photographs — being of the living plant — are valuable as records.

Structure and Community

The varying structures, architecture and plant communities of the wieden are shown in Fig. 1.3 (which should be looked at again at this point, now also noting the prominent plant species named in the captions). These show not just different types of river valleys, but the main different types of vegetation: aquatic, marsh, damp and dry river beds, of varying seasonal aspects; garigue (with short woody plants on dry shallow soil); maquis (medium sized trees and shrubs, largely with tough evergreen leaves, and an associated underflora); deciduous trees (with frailer leaves falling in winter, usually in damper places, e.g. spring zones) etc.

Animals

Even less work has been done on wieden animals than wieden plants. Table 3.1

Table 3.1
Endangered Animal Species

(Lanfranco, Schembri and Sultana, 1989. No birds are listed as typical of river valleys)

<i>Acheta palmatorum</i>	(field cricket)	Damp places
<i>Argiope bruennichi</i>	(large spider)	Kbir
<i>Bledius tricornis</i>	(rove beetle)	Perennial springs
<i>Brachygluta dentiventric</i>		River
<i>Caelostoma orbiculare</i>		Freshwaters
<i>Chamaelo chamaeleon</i>	(Mediterranean chamaeleon)	Introduced trees and shrubs
<i>Chlaenius olivieri</i>	(beetle)	Damp places
<i>Chlaenius velutinus auricollus</i>	(beetle)	Damp places
<i>Cicindela melancholica</i>	(tiger beetle)	Damp places
<i>Discoglossus pictus pictus</i>	(painted frog)	Once common, now loss, pollution and disturbance
	restricted by habitat	Springs etc.
<i>Dytiscus circumflexus</i>	(diving beetle)	Perennial water
<i>Echinogrammarus ebusitanus</i>	(sand hopper)	
<i>Echinogrammarus pungens</i>	Similar	
<i>Epidola melitensis</i>	(moth)	Extinct
<i>Epomis circumscriptus</i>	(beetle)	Rivers
<i>Erinaceus alpinus</i>	(Algerian hedgehog)	
<i>Helophorus algericus</i>		Freshwaters
<i>Helophorus pallidipennis</i>		Freshwaters
<i>Helophorus porculus</i>		Freshwaters
<i>Helophorus dorsalis</i>		Freshwaters
<i>Heterocerus melitensis</i>	(mud-burrowing beetle)	Muddy edge
<i>Haemaphysalis sanguisuga</i>	(horse leech)	Permanent spring, Goza
<i>Hydraena nigrita</i>		Freshwaters
<i>Ischnura genei</i>	(damselfly)	Freshwater
<i>Laccophilus interruptus</i>	(diving beetle)	Springs etc.
<i>Lymnaea palustris</i>	(marsh snail)	Extinct
<i>Lymnaea peregra</i>	(wandering snail)	Extinct
<i>Lymnaea truncata</i>	(dwarf pond snail)	Much water
<i>Meladonia ceriaceum</i>	(diving beetle)	Springs etc.
<i>Mercuria cf. similis</i>	(freshwater spire snails)	Much water
<i>Mutilla maroccana</i>	(mutilloid wasp)	Rivers
<i>Ochthebius exavatus</i>	(vegetarian water beetle)	Water
<i>Ochthebius impressivallis</i>	(vegetarian water beetle)	Water
<i>Ochthebius subinteger</i>	(vegetarian water beetle)	Water
<i>Orthetrum brunneum</i>	(dragonfly)	Perennial water
<i>Physella acuta</i>	(bladder snail)	Much water
<i>Potamon fluviatile</i>	(Maltese freshwater crab)	Permanent springs
<i>Pseudamnicola melitensis</i>	(freshwater spire snails)	Much water
<i>Trochoidea sprattii cucullus</i>	(top snail)	Spring area

Groupings occurring in different sites are listed later in the Chapter

shows the endangered animals of the Red Data Book, those decreasing and in danger of becoming extinct, or already presumed extinct.

Plants

The general vegetation types are demonstrated in Fig. 1.3: those of river beds (wet, damp, dry), of garigue, maquis, wayside, etc. The Index of Plant Names at the back of the book lists the Maltese and English names of the Latin Names here given. (Non-botanists should, at least at first reading, omit the following tables, except for their headings.)

Red Data Book species are in Table 3.2, and more detailed habitat listings, in Table 3.3

Table 3.2
Endangered Plant Species

(Lanfranco, Schembri & Sultana, 1989)

<i>Alopecurus pratensis</i>	(meadow foxtail)	Extinct
<i>Anthoxanthum odoratum</i>	(sweet vernal-grass)	Extinct
<i>Aristolochia clusii</i>	no definition	Damp valleys
<i>Bromus alopecurus</i>	no definition	Valleys
<i>Callitriche truncata</i>	(water-starwort)	Rock pools
<i>Carex halleriana</i>	(southern sedge)	Valleys
<i>Catabrosa aquatica</i>	(whorl grass)	Damp places
<i>Crataegus azarolus</i>	(Crete hawthorn)	Valleys
<i>Cyperus distachyos</i>	(Mediterranean galingale)	Extinct
<i>Cyperus fuscus</i>	(brown galingale)	Valleys
<i>Damasonium bourgaei</i>	(starfruit)	Water
<i>Euphorbia pubescens</i>	(not listed in Index at all)	Valleys
<i>Glyceria plicata</i>	(plicate sweet-grass)	Damp places
<i>Iris foetidissima</i>	(stinking iris, gladdon)	Valleys
<i>Iris pseudacorus</i>	(sweet flag, yellow iris)	Extinct
<i>Isolepis (Scirpus) cernua</i>	(slender clubrush)	Extinct
<i>Juncus capitatus</i>	(dwarf rush)	Extinct
<i>Laurus nobilis</i>	(Laurel)	Valleys
<i>Lotus preslii</i>		Valleys
<i>Malope malachoides</i>	(hairy mallow)	Valleys
<i>Mentha aquatica</i>	(water mint)	Extinct
<i>Mentha suaveolens</i>	(round-leaved mint)	Extinct
<i>Mespilus germanica</i>	(medlar)	Extinct
<i>Polygonum glabrum</i>	(not listed at all)	River
<i>Polygonum salicifolium</i>	(willow-leaved knot-grass)	Permanent spring
<i>Populus alba</i>	(white poplar)	Damp valleys
<i>Potamogeton pectinatus</i>	(fennel pondweed)	Water
<i>Putoria calabrica</i>	(stinking madder)	Valley

Plants and Animals

<i>Ranunculus bulbosus</i> ssp. <i>adsendens</i>		Extinct?
<i>Ranunculus ophioglossifolius</i>	(spearwort)	Extinct?
<i>Rosa sempervirens</i>	(evergreen rose)	Valleys
<i>Salix alba</i>	(white willow)	Damp valleys
<i>Salix pedicellata</i>	(Mediterranean willow)	Damp valleys
<i>Sambucus ebulus</i>	(dwarf elder)	Damp places
<i>Schoenus nigricans</i>	(black bog-rush)	Wet places
<i>Scirpus maritimus</i>	(sea club-rush)	Damp valleys
<i>Scrophularia auriculata</i>	(water figwort)	Damp places
<i>Sorbus aucuparia</i>	(rowan, mountain ash)	Extinct
<i>Sparganium erectum</i>	(branched bur-reed)	Extinct
<i>Spartium junceum</i>	(Spanish broom)	Valleys
<i>Teucrium scordium</i>	(water germander)	Damp places
<i>Vicia bythinica</i>		Valleys
<i>Zannichellia palustris</i>	(horned pondweed)	Rivers

Table 3.3
Wied Habitats and their Plants

The habitat divisions here are arbitrary, and could be satisfactorily grouped differently (lists are extracted from Floras, with additions from Mr. E. Lanfranco).

1. Along and in streams

<i>Alisma plantago-aquatica</i>	<i>Polygonum glabrum</i>	<i>Ranunculus ophioglossifolius</i>
<i>Apium graveolens</i>	<i>Polygonum persicaria</i>	<i>Rumex conglomeratus</i>
<i>Apium nodiflorum</i>	<i>Polygonum salicifolium</i>	<i>Salix pedicellata</i>
<i>Centaurium tenuifolium</i>	<i>Potamogeton pectinatus</i>	<i>Samolus valerandi</i>
<i>Juncus articulatus</i>	<i>Populus alba</i>	<i>Scirpoides holoschoenus</i>
<i>Lemna minor</i>	<i>Potentilla reptans</i>	<i>Scolymus maculatus</i>
<i>Myriophyllum verticillatum</i>	<i>Ranunculus trichophyllus</i>	<i>Trifolium fragiferum</i>
<i>Nasturtium officinale</i>	<i>Ranunculus bulbosus</i>	<i>Veronica anagallis-aquatica</i>
	ssp. <i>adsendens</i>	<i>Veronica beccabunga</i>
<i>Oenanthe globulosa</i>	<i>Ranunculus fluitans</i>	
	(extinct)	
<i>Phragmites australis</i>	<i>Ranunculus fontanus</i>	

2. Damp places, shaded valleys, etc.

<i>Adiantum capillus-veneris</i>	<i>Echinochloa colonum</i>	<i>Plantago major</i>
<i>Agrostis stolonifera</i>	<i>Echinochloa crus-galli</i>	<i>Poa trivialis</i>
<i>Alopecurus pratensis</i>	<i>Epilobium parviflorum</i>	<i>Polygonum salicifolium</i>
<i>Ampelodesma mauritanica</i>	<i>Epilobium tetragonum</i>	<i>Polypogon maritimus</i>
<i>Anogramma leptophylla</i>	<i>Equisetum ramosissimum</i>	<i>Polypogon monspeliensis</i>
<i>Anthoxanthum odoratum</i>	<i>Geranium purpureum</i>	<i>Puccinellia fasciculata</i>
<i>Arundo donax</i>	<i>Iris foetidissima</i>	<i>Pulicaria odora</i>
<i>Asplenium maritimum</i>	<i>Iris pseudacorus</i>	<i>Ranunculus chius</i>
<i>Bellis sylvestris</i>	<i>Juncus acutus</i>	<i>Ranunculus ficaria</i>

Brachypodium sylvaticum
Cardamine hirsuta
Carex distans
Carex divisa
Carex divulsa
Carex flacca
Carex hallerana
Carex otrubae
Carex spicata
Cerinth major
Coronopus squamatus
Crataegus azarolus
Crataegus monogyna
Cyperus distachyos
Cyperus fuscus
Cyperus longus

3. Rock pools

Callitriche truncata
Callitriche stagnalis
Crassula vaillantii
Damasonium bourgaei

Juncus capitatus
Juncus effusus
Juncus subulatus
Lotus corniculatus
Lythrum hyssopifolium
Lythrum junceum
Medicago arabica
Mentha aquatica
Mentha suaveolens
Mespilus germanica
Milium vernale
Ophrys apifera
Panicum repens
Phalaris caerulea
Phalaris tuberosa
Plantago lanceolata

Elatine gussonei
Eleocharis ovata
Isoetes hystrix
Juncus bufonius

Rosa gallica
Rosa sempervirens
Rumex pulcher
Schoenus nigricans
Smyrniolus olusatrum
Sorghum halepensis
Symphitum officinale
Teucrium scordium
Triglochin bulbosa
Triglochin laxiflorum
Vicia peregrina
Vicia tetrasperma
Viola odorata
Xanthium strumarium

Ranunculus baudotii
Ranunculus trichophyllus
Zannichellia palustris

4. Valley woody plants (more general habitats, general)

Cercis siliquastrum
Cistus incanus
Clematis cirrhosa
Crataegus azarolus
Crataegus monogyna
Cydonia oblonga
Erica multiflora
Ficus carica
Fraxinus angustifolia
Hedera helix
Lonicera implexa

Mespilus germanicus
Myrtus communis
Olea europaea
Pistacia lentiscus
Pistacia terebinthus
Prunus cerasus
Prunus crassifera
Prunus domestica
Prunus dulcis
Prunus mahaleb
Prunus spinosa

Punica granatum
Pyrus amygdaliformis
Pyrus pyraeaster
Rhus coriaria
Ricinus communis
Rosmarinus officinalis
Sambucus ebulus
Sorbus aucuparia
Sorbus domestica
Vitex agnus-castus
Zizyphus jujuba

5. Valley plants of rocky places

Anacamptis pyramidalis
Anagyris foetida
Anthoxanthum gracile
Asphodelus fistulosus
Blackstonia perfoliata
Briza maxima
Bromus alopecurus
Centaurea crassifolia
Centaurea erythraea

Centranthus calcitrapa
Chiladenus bocconeii
Coronilla emeris
Coronilla valentina
Crassula tillaea
Cynosurus echinatus
Dittichia viscosa
Erica multiflora

Euphorbia characias
Euphorbia dendroidea
Euphorbia melitensis
Gastroidium ventricosum
Hyparrhenia hirta
Hypericum aegypticum
Iris germanica
Iris sicula
Lathyrus spha
Lathyrus sphaericus
Lavatera trimestris
Melica arrecta
Micromeria graeca
Muscari parvifolium
Ononis ornithopodioides
Ophrys bombyliflora
Orchis italica
Orchis lactea

Orchis saecata
Phlomis fruticosa
Pistacia lentiscus
Punica granatum
Pyrus amygdaliformis
Rhus coriaria
Rubia peregrina
Sedum sediforme
Spartium junceum

Sulla peruviana
Torilis arvensis
Trifolium lapaceum
Umbilicus horizontalis
Umbilicus rupestris
Vulpia ciliata

over-dry and over-disturbed, with a low-diversity flora of predominantly ruderal species. Ruderals are species of waste ground found e.g. near building sites. They barely grow in undisturbed and stable habitats, as they require or tolerate well the high nutrients (and perhaps soft soil, no shade), found where soil has been disturbed, and do not well tolerate the high competition of proper, traditional, communities.

The presence of ruderal species, still more their abundance, in river beds, is a sure indication of habitat degradation; as is the presence of any land species in winter on the bed of a main river (which ought to be wet). Grech Delicata (1853) may be taken as a base-line as the surveys were recorded before drying and disturbance became serious. Lapses from that record are evidence of degradation. This flora was not comprehensive, so absence of mention signifies nothing. Thirty-eight species are recorded in flowing waters, still waters and damp places. Only two (*Rumex conglomeratus* and *Arundo donax*) appear in Table 3.4

Table 3.5
 Water Species in Grech Delicata (1853) and in the 1990s

(a) Grech Delicata (names updated): River

Alisma plantago-aquatica
Apium graveolens
Apium inundatum
Apium nodiflorum
Colocasia esculenta
Cyperus badius
Cyperus longus (margins)
Cyperus papyrus
Eleocharis palustris
Epilobium Tetragonum (edges)
Glyceria maxima (edges)
Glyceria plicata
Lemna minor (still/slow)
Lythrum junceum
Mentha aquatica
Nasturtium officinale
Ranunculus fluitans
Scirpoides holoschoenus
Scirpus maritimus
Veronica anagallis-aquatica
Zannichellia palustris

(b) Grech Delicata (names updated): Still

15 additional species, including:
Elatine Macropoda
Oenanthe globulosus
Ranunculus peltatus
Schoenus nigricans
Scirpus lacustris
Sparganium erectum
Typha domingensis
Veronica bettabunga

(c) 1990s (frequent)

Alisma plantago aquatica
Apium nodiflorum
 Blanket weed (algae)
Cyperus longus
Lemna minor
Nasturtium officinale
Ranunculus trichophyllus
Scirpoides holoschoenus
Typha domingensis
Veronica anagallis-aquatica

Pattern (a) in Table 3.5 is entirely consistent with limestone rivers further north in Europe. Potamogetons are absent (by recording, or really so?) but the number of submerged species (9) is satisfactory, especially if most or all occurred in most places. The vegetation is *Ranunculus*-based with minor other species which are not nutrient-rich in habitat preference. (*Zannichellia palustris* is, though, not nutrient-poor. It now occurs widely in Sicilian rivers and seems to increase (geographically) in the south of Europe.) On margins there are at least 5 wide-leaved low herbs, both small bushy (e.g. *Mentha aquatica*) and large-leaved (e.g. *Alisma plantago-aquatica*). (The former are more limestone, the latter, more clay and silt in distribution.) There is also a good supply of fringing tall monocotyledons. The diversity of these increases in southern Europe (as compared to northern Europe) and at 11, the Malta representation is in line.

That is, the Grech Delicata list suggests good limestone streams, with the southern component of tall monocotyledons, and possibly the present southern feature of few submerged species (now due to summer drying and pollution in the southern Mediterranean). Bearing in mind that the records are incomplete, a river vegetation was present of which all could be proud.

The 1990s list, on the other hand, can merely be called degraded. It is not even plain from the list alone what it has been degraded from. It requires the knowledge of the limestone rock, or of Grech Delicata, or both, to interpret it. *Typha domingensis* is the only species now increasing, probably as it is pollution-tolerant and pollution is increasing. (The same applies to the damp rather than aquatic species *Rumex conglomeratus*.) It is hard to identify river communities as such, species occur where habitat permits, but the habitats are so small and so generally inadequate that few are alike, and most bear jumbled collections of a small number of species (see Fig. 1.3). Moreover, many of the 1990s species are characteristic of damp soil rather than water.

This is the main change, this with the parallel loss in damp (rather than flooded) habitats. Borg (1927) was working in an intermediate phase, so although his Flora is comprehensive, it is less valuable for establishing the change since baseline. Borg specifically states perennial water plants are very few and gradually disappearing. (His Flora can profitably be studied for the 1920s pattern.)

Another, and quite different line of enquiry concerns change over a few decades, rather than of a century and a half. Comparing aerial photographs of the 1950s and 1960s with those of the 1990s shows changes in

woody plants (trees and shrubs). The alterations are small, and the types include:

1. Little change: as in the very wooded Wied Babu, (the sparsely wooded Chadwick Lakes), and Wied Has-Saptan.
2. Increased trees: as downstream, Sewda, the Wied il-Qirda part of Kbir, parts of Ghasel (mouth-exotics-Wied il-Busbies, Wied Ghajn-Rihana), and Selmun Valley.
3. Increased *Arundo donax*: as in Mistra Valley, Bahrija valley.
4. Decreased trees: as in part of Mistra valley, Wied Speranza (Ghasel).

Increases in the numbers of trees are more from planting than from natural regeneration from seed. Planting has too often been of eucalypts by hunters, or included eucalypts, acacia and palm by the Agricultural Department which, in the late 1960s and early 1970s, thought these were appropriate even in the rural areas to obtain quick tree cover. Lately there has been afforestation with native species. This should be extended (see Appendix 1, and Chapter 16) and the planting of other species stopped completely. In open parts, trees are unlikely to grow from seed as — apart from germination and establishment difficulties on sunlit soil — grazing, trampling, cultivation and picking are ubiquitous, so few seedlings survive.

The loss of river plants was primarily due to abstraction for mains and farming supply. The pollution changes described above are mainly recent, though in the 1850s there could well have been severe pollution near settlements, rivers being used for waste disposal e.g. from Mount Carmel Hospital — when the Lunatic asylum — to the Sewda in the 1890s, as Mr Chadwick reported. This was largely stopped with sewerage (see Chapter 7). The changes in trees are from intentional and planned policies of planting (or cutting down); those in *Arundo donax*, to neglect, to the failure of management. It is significant that the most noticeable and important alterations are those due to water abstraction and to neglect.

A third change is the increase of ruderals. This has presumably been happening since at least the 1890s, when water shortage was becoming noticeable. (The phenomenon has been studied in other countries, so the assumption that many ruderals mean habitat degradation is well-founded.) Now, there are many kilometres of watercourse dominated by ruderals, more with ruderals mixed in with damp or dry riverbed species. There is also much covered by roads and lanes.

Places of Conservation Importance

The more the wieden are studied, the more, fortunately, are places of conservation importance discovered. There is still high-quality vegetation in Malta! Schembri *et al.* (1987) list sites bearing rare species rather than special or representative plant communities. These include parts of:

Mistra Valley	Bahrija Valley
Wied Has-Saptan	Wied San Martin
Wied Babu	Wied Gerzuma
Wied iz-Zurrieq/W. Hoxt	Gnejna Valley
Wied Maghluq	River Kbir system (Girgenti, Luq, etc)
Wied Migra Ferha	Wied il-Faham (and Dis)
Wied ir-Rir	Wied Anglu
Pwales	River Ghasel system (Wied Qannotta, Wied il-Ghajj Rihana, Wied il- Qlejgha, Wied Speranza, Wied il- Ghasel, Fiddien)

This includes a respectable sample of river valleys, to which can be added the valuable places described at the end of this chapter, in Chapters 12 and 13, and in Appendix 2. Even these are far from complete; the wied surveys of 1986-97 have found many gems. To retain them as gems will take planning, either merely the prevention of harm (e.g. dumping, construction, off-roading) or the active enhancement of habitat (e.g. more trees, more water, less *Arundo*, less concrete). Planning is described in Appendix 1, which should be followed except for minor measures of harm prevention, such as stopping dumping. Habitats are governed by many and complex impacts, natural and man-made, and single elastoplast measures will be no more use on a valley in an unstable or degraded state than on a man run over by a bus. Understanding of the interlocking habitat factors is essential before tampering with one of them. For example, vegetation may be short with many bare patches because, among other reasons:

- (a) rock outcrops over much of the ground (leave);
- (b) site examined in September (visit again);
- (c) too much grazing;
- (d) too many people walking.
- (e) too much of other forms of recreation;
- (f) shallow soil coupled with (c)–(e) (so more susceptible);
- (g) failure, as yet, to recover from excavation;
- (h) over-much and unstable silt accumulation;

- (i) recent drying;
- (j) in spring, water recently taken e.g. by bowser, habitat damaged by over-rapid water removal;
- (k) is a rubble dump, or recently was a rubble or rubbish one;
- (l) heavy shade from native trees (leave);
- (m) poisoned by pollution.

It is a waste of money, time and goodwill to try to remedy any of the above without knowing which is responsible. It is more than likely, anyway, that there will be secondary causes active as well. For example, pollution damage — like all other — is aggravated by any other factor unsatisfactory for plant growth. Damage tends to be cumulative or even synergistic (when the effect of damage factors is worse than the sum of these separately).

Seasonal Changes

These require much more study, but some general patterns are known. There is no (or little) part of the year when temperature prevents plant growth. The lack of rain (and diversion of spring water) limits growth in summer. Consequently there may be autumn, spring and summer communities (the latter drying where not supplied with water, naturally or by irrigation), and divisions within. The main tall monocotyledons like *Phragmites australis*, *Arundo donax*, and *Typha domingensis* are summer-green, obtaining sufficient water from the ground. Most water-supported species, though, are necessarily now winter-greens (much water drying in summer so leaving no water for the species). In Chadwick Lakes, for instance, communities change with soil texture, water level and its variation, annually as well as by the time of year (see Chapter 16). The same variation would occur in equally satisfactory other watercourses, and to a much lesser extent in degraded habitats.

The Plants and Animals of Some Places in Wieden

(Modified from the Excursion Notes of the SSCN, written by Mr. E. Lanfranco, with Professor P.J. Schembri and others, by kind permission of the Society for the Study and Conservation of Nature.) The month of survey is noted, since species present vary greatly with season (see above).

Fig 1.3 and its captions should again be consulted here, either before or after reading the descriptions. For the Ghasel, see also Chapter 12 and Appendix 2; Kbir, Chapter 12 and (Qirda) Appendix 2; Wied Babu, Chapter 13; Bahrija valley, Chapter 13; Wied il-Faham, Chapter 13; Wied Has-Saptan, Appendix 2 and Mistra Valley, Appendix 2. Those who find the descriptions too complex should move to Chapter 4, and return here after reading to the end of the book.

1. River Ghasel System (also see Chapter 12, and Appendix 2)

(a) Fiddien Valley (May)

The fauna and vegetation of Fiddien Valley is typical of that of watercourses and includes a variety of sedges and grasses. The sedges are wiry rhizomatous plants which usually bear brownish flower heads. The flowers are wind pollinated. The main types at Fiddien are: divided sedge (*Carex divisa*), distant sedge (*Carex distans*), false fox sedge (*Carex otrubae*), round-headed club-rush (*Scirpoides holoschoenus*), and galingale (*Cyperus longus*). Many grasses are suited to waterlogged habitats, e.g. the striking annual beard-grass (*Polypogon monspeliensis*), water bent (*Polypogon viridis*), fescue (*Festuca arundinacea*).

Other plants associated with the watercourse include the willow herb (*Epilobium tetragonum*), large-leaved buttercup (*Ranunculus bulbosus* ssp. *adscendens*), purple loosetrife (*Lythrum junceum*), pennyroyal (*Mentha pulegium*), creeping cinquefoil (*Potentilla reptans*), round head water-dropwort (*Oenanthe globulosa*).

Some grasses, while not strictly tied to watercourses, seem to do best in such habitats and these include the perennial rye-grass (*Lolium perenne*), cockscomb grass (*Dactylis glomerata*), and wild millet (*Panicum repens*). Along the valley there are strands of great reed (*Arundo donax*), and the rarer lesser reed (*Arundo plinii*). At the beginning of the valley there is a planted pecan nut (*Carya olivaeformis*), and some white poplars (*Populus alba*). Other trees include fig (*Ficus carica*), olive (*Olea europaea*) and carob (*Ceratonia siliqua*). Also present is the castor oil tree (*Ricinus communis*), a native of Africa which has become very common. In part of the valley there are stands of rough cocklebur (*Xanthium strumarium*), demigods' food (*Chenopodium ambrosioides*) and wild aster (*Aster squamatus*), all three of which are natives of North America.

In the water itself there are water plantain (*Alisma plantago-aquatica*),

water speedwell (*Veronica anagallis-aquatica*), water crowfoot (*Ranunculus trichophyllus*) and horned pondweed (*Zannichellia palustris*).

Wetlands also support a rich animal life and Fiddien Valley is no exception. Aquatic animals include the great diving beetle (*Dytiscus* sp.), water boatman (*Notonecta* sp.), damsel fly (*Ischnura genei*), red dragonfly (*Crocothemis erythraea*), emperor dragonfly (*Anax imperator*), the painted frog (*Discoglossus pictus*), a small orange-red beetle (*Labidostoma taxicornis*) (quite numerous) and several butterflies including the common blue (*Polyommatus icarus*), painted lady (*Cynthia cardui*), speckled wood (*Pararge aegeria*), wall brown (*Lasiommata megera*), small copper (*Lycaena phlaeas*), large white (*Pieris brassicae*) and the Maltese meadow brown (*Maniola jurtina hyperhispulla*).

As part of a rehabilitation scheme, much of the Fiddien Valley was dredged in 1997 for the removal of accumulated sediment. Recovery of the plants and animals will take time, and for those already stressed by lack of water and too much pollution, recovery may not occur.

(b) Wied il-Ghasel near Mosta (November; end paragraphs March)

Wied il-Ghasel, near Mosta, was possibly the most picturesque and rich of the wadies, but it has suffered more than its fair share at the hands of man. Framed in the magnificent cornice of this valley, are dumps, refuse, quarries, mutilations, tasteless constructions. Many of the rare species which once graced this wadi are no longer to be seen. The last of the Sicilian spider orchid (*Ophrys oxypetala*), succumbed to the quarry in the early 1960s. The blue squill (*Scilla peruviana*) can now be seen only in cultivation, while the rare and unique sandarac tree (*Tetraclinis articulata*) still existed here until fairly recently. Among the more significant plants are autumn flowering bulbs such as the autumn squill (*Scilla autumnalis*), early narcissus (*Narcissus serotinus*) and autumn spear grass (*Triglochin laxiflorum*). Among early-flowering species, autumn buttercup (*Ranunculus bulbatus*) with shiny yellow flowers, the Portuguese wood-daisy (*Bellis sylvestris*) with white flowers having a purplish tinge on the outside, the tuberous hawk's beard (*Leontodon tuberosus*) looking very much like dandelion and the small sage (*Salvia verbenaca*). Other plants here bloom nearly all the year e.g. calaminth (*Calamintha nepeta*), with strongly aromatic leaves, the Maltese savory (*Micromeria microphylla*) growing flat on the ground and sweet alison (*Lobularia maritima*). Several shrubs may be seen along the valley sides. These include the two species of germander

(*Teucrium fruticans* and *Teucrium flavum*), white hedge-nettle (*Prasium majus*), Mediterranean heath (*Erica multiflora*), the endemic Maltese fleabane (*Chiliadenus bocconei*), the occasional wolfbane (*Periploca angustifolia*) and the stinking madder (*Putoria calabrica*). In crevices on moist shaded rocks are three species of ferns: the tiny Jersey fern (*Anogramma leptophylla*), the common maidenhair fern (*Adiantum capillus-veneris*) and the rustyback fern (*Asplenium ceterach*). The valley sides support numerous trees, many of which are of cultivated origin. These include olives, carobs, almonds, figs, prickly pear accompanied by bramble (*Rubus ulmifolius*) and asparagus (*Asparagus aphyllus*). On the steep side are magnificent populations of tree spurge (*Euphorbia dendroides*) and great sage (*Phlomis fruticosa*).

> Close to the road, the valley floor flora is typical of disturbed ground: bright yellow crown daisy (*Chrysanthemum coronarium*), mallows (*Lavatera* and *Malva* spp.) species, thistles such as the bur thistle (*Galactites tomentosa*) and milk thistle (*Silybum marianum*), and the ubiquitous cape sorrel (*Oxalis pes-caprae*).

> The watercourse is dominated mainly by clustered dock (*Rumex conglomeratus*), with large leaves. Along the sides are buttercups, (*Ranunculus muricatus*), with small, shiny yellow flowers and spiny fruits, as well as resupinate clover (*Trifolium resupinatum*), storkbills (*Erodium malachoides* and *Erodium moschatum*) etc.

Close to the large bridge is *Putoria calabrica* which flowers in early summer. It was almost destroyed by the construction of the bridge.

(c) Salini Bay (December)

Salini Bay, at the mouth of the Wied il-Ghasel, is the only remaining estuarine locality which still supports the flora and fauna typical of such habitats. Alas, Salini has been degraded. Nevertheless it still supports an interesting community. The plants of an estuary, where fresh water meets sea water, are halophytes, i.e. capable of surviving conditions of high salinity. Since salt interferes with water uptake, halophytes have adaptations which are similar to those required in dry conditions. The most striking plant is the common reed (*Phragmites australis*) which is still in fruit, and is rooted in the brackish water. Along the banks are tamarisk trees (*Tamarix africana*) which were originally planted, but they are true natives and ideal for such saline situations. It is probable that the tamarisks existed here before the area was degraded. The lower growth

consists mainly of rushes (*Juncus subulatus* and *J. acutus*) and various succulent plants such as seabites (*Suaeda maritima* and *Suaeda vera*), golden samphire (*Dittichia crithmoides*) saltworts (*Salsolakali* and *Salsola soda*) and glasswort (*Salicornia ramossissima*). Among the rarer plants are *Cressa cretica*, a low herb with numerous small whitish leaves. The submerged fauna includes a variety of species such as the killifish (*Aphanius fasciatus*), which exists as a local race and the painted frog (*Discoglossus pictus*) which seems to tolerate saline conditions. Among the invertebrates are sand hoppers (*Amphipods*) which jump much like fleas, as well as tiny crustaceans such as Ostracods and Copepods. Larvae of crane flies (known as "leather jackets") and of mosquitoes are also abundant. It is possible to encounter empty shells of the water snail (*Melanoides tuberculata*) which used to exist in a freshwater spring which has since been destroyed.

(d) Wied Qannotta (May)

Wied Qannotta is one of the richest watercourses in Malta. The flora is typical and includes a variety of sedges, rushes and grasses. The sedges (family: Cyperaceae) look somewhat like grasses but their stems are not hollow and are very often triangular in section. The commonest sedges are divided sedge (*Carex divisa*), round-headed club rush (*Scirpoides holoschoenus*) and spike-rush (*Eleocharis palustris*). The rushes (family: Juncaceae) also look somewhat like grasses and sedges but close examination reveals that their flowers have six perianth segments (i.e. sepals/petals) and three or six stamens; indeed they are more closely related to the lily family than to the grasses and sedges; toad-rush (*Juncus hybridus*) and jointed-rush (*Juncus articulatus*) are present. The grasses (family: Graminae) include: fescue (*Festuca arundinacea*) and the attractive beard grass (*Polypogon monspeliensis*). On drier ground there is an abundance of rye-grass (*Lolium rigidum*), cock's comb grass (*Dactylis glomerata*) and the uncommon *Bromus alopecurus*. Grasses, sedges and rushes are often especially suited for this type of habitat because of their extensively branched roots and rhizomes (subterranean stems) which are able to anchor plants in unstable waterlogged mud.

Other characteristic plants include the bulrush (*Typha domingensis*), which appears to be on the increase (see Chapter 7), dock (*Rumex sanguineus*), purple loosetrife (*Lythrum junceum*), water speedwell (*Veronica anagallis-aquatica*) and pennyroyal (*Mentha pulegium*). Submerged plants include the water crowfoot (*Ranunculus trichophyllus*) and

the stonewort (*Chara* sp.), a complex green alga.

The first part of Wied Qannotta is much disturbed and supports communities characteristic of waste and disturbed ground. The most conspicuous of these plants is the crown daisy (*Chrysanthemum coronarium*), whose bright yellow flowers attract a number of insects including bees (*Hymenoptera*, *Apidae*) such as honey bees (*Apis mellifera*), and halictid bees (*Halictus* sp.), (family: Halictidae. There are smaller syrphid flies (*Diptera*: *Syrphidae*) also called hoverflies, such as the common *Eristalis tenax*, a number of beetles (*Coleoptera*) of which the most conspicuous are *Oxythyrea funestra* and *Tropinota squalida* (family: Cetoniidae) and also a number of small, colourful species such as *Psilothrix* sp. (family: Cantharidae), *Bruchus* sp. (family: Bruchidae) and *Attenuatus* sp. (family: Dermestidae). A number of crab spiders (*Araneae*: *Thomisidae*) lurk under the petals awaiting insect prey which they capture by means of elongated front legs. The two largest are the bright yellow (sometimes white) *Thomisus onustus* and the smaller black and orange (or black and yellow) *Synema globosa*.

On the ground amongst the grass stalks the scarab (*Atheus variolus*) (family: Scarabaeidae) rolls its balls of dung on to which it will later lay its eggs.

Juvenile painted frogs (*Discoglossus pictus*) seek shelter and moisture in the watercourse. The pools have tadpoles. Round the edges of drying pools a number of invertebrates congregate. Rove beetles (family: Staphylinidae) such as species of *Philonthus* and smaller *Atheta* seek moisture under the alga *Chara*. Here also lurk wolf spider (*Araneae*: *Lycosidae*) which are voracious predators, and a colourful carabid beetle (family: Carabidae), *Calathus melanocephalus*. A large number of different species of fly (*Diptera*) settle on the wet mud or the water. The largest of these is the crane fly (*Tipula* sp., family: Tipulidae) which has an aquatic larva which feeds on decaying plant matter.

In the water itself are the water beetles (*Meladema coriaceum* and *Dysticus circumflexus*) and their larvae. The larvae and adults of the latter species are highly predaceous and feed on a variety of prey including tadpoles and young frogs. Another common predator in the pools is the backswimmer (*Notonecta maculata*) (family: Notonectidae) which is not a beetle but a bug (*Hemiptera*). A species of freshwater isopod (*Crustacea*: *Isopoda*), probably *Laniropsis epilittoralis* is found in large numbers under stones round the pool edges. Dragonflies and damselflies (*Odonata*) hover above the water and occasionally alight on the vegetation round the pools.

edges, including the emperor dragonfly (*Anax imperator*), *Crocothemis* sp. and the Malta damselfly (*Ischnura genei*). *Paratettix meridionalis* is a small grasshopper (*Orthoptera*) always found near freshwater. When disturbed, this species may jump into the water and swim away with powerful strokes of its legs.

2. River Kbir system (see also Chapter 12 and Appendix 2)

(a) Wied il-Luq and Buskett (October, last vegetation paragraphs November)

Buskett is the only spot on the Island which is still wooded. The present wood has been largely planted during the rule of the Order of St John to augment a small natural wood, dominated by the holly oak (*Quercus ilex*) and Aleppo pine (*Pinus halepensis*) (see Chapter 12). The pines were originally planted. These and most other trees and shrubs are evergreen. The leaves are hard because they have a thick cuticle to prevent water loss. Other trees in the wooded region are the bay laurel (*Laurus nobilis*), buckthorn (*Rhamnus alaternus*), olive (*Olea europaea*), hawthorn (*Crataegus monogyna*). There are also several climbing shrubs, like ivy (*Hedera helix*), spiny asparagus (*Asparagus acutellus*), (*Smilax aspera*), madder (*Rubia perezii*), honeysuckle (*Lonicera implexa*), and traveller's joy (*Clematis cirrhosa*). Further up the rocky sides the wood gives way to the maquis dominated by the lentisk (*Pistacia lentiscus*), carob (*Ceratonia siliqua*) and fig (*Ficus carica*).

Down in Wied il-Luq are trees such as white poplar (*Populus alba*), ash (*Fraxinus angustifolia*), pecan nut (*Carya olivaeformis*), and elms (*Ulmus glabra* and *U. minor*). Along the watercourse are several sedges (mainly *Carex divulsa*) as well as a few specimens of the gladdon (*Iris foetidissima*). This is a kind of iris. A close examination of the water reveals numerous small animals. These include a number of freshwater snails such as the bladder snail (*Physa acuta*), Maltese spire snail (*Pseudamnicola melitensis*), river limpet (*Ancylastrum fluviatile*) and an American ramshorn snail (*Helisoma duryi*). Flatworms (*Planaria*) and pond skaters (*Asellus*) are also numerous.

On land, insects are the most abundant form of invertebrate life. Ivy flowers attract many insects, amongst which flies (*Order Diptera*) and wasps (*Order predominate Hymenoptera*). Another group of flower-loving insects are the butterflies (*Order Lepidoptera*). The most abundant species

now is the painted lady (*Cynthia cardui*). White butterflies (*Pieris brassicae*, *Pieris rapae* and *Pontia daplidice*) also occur but are less numerous.

The common blue butterfly (*Polymmatius icarus*) is also present. Both sexes seek resting places among long dry grass. The male is easily recognised by its shiny blue wings, those of the female being a lustrous brown.

Dry grass harbours various insects. Grasshoppers (Order Orthoptera) are especially abundant here. A species of *Calliptamus* is easily disturbed and readily takes to flight. This species shows a marked sexual dimorphism, the female being much larger than the male. Apart from size the male is also easily distinguished by the pair of large claspers at the tip of the abdomen. Mantids (Order Dictyoptera) hide among thick vegetation, e.g. common praying mantis (*Mantis religiosa*), and the rare flightless mantid, (*Ameles* sp.). These insects, though unable to fly, are able jumpers. Mantids lie hidden among vegetation and ambush any unwary insect that comes their way.

Ground dwelling insects are also numerous, the most obvious are the harvester ants (*Messor* spp.). These ants form small mounds of discarded material around their nest entrance.

A large number of spiders live at Buskett. The characteristic webs of the basilica spider (*Cyrtophora citricola*) abound on bushes, especially those of juveniles which have hatched recently. Other webs to be seen are the tangled webs of spiders of the family Theridiidae, the funnel-shaped webs of spiders of the family Agelenidae and, occasionally, the orb webs of *Argiope lobata*, one of the largest Maltese spiders. Under stones are found many spiders of the family Drassidae as well as minute spiders, only a few millimetres in length, of the family Linyphiidae. Harvestmen, which are not spiders but members of a related order called Opiliones, also occur under stones.

Two species of snails are frequently found resting on walls. These are *Eobania vermiculata* whose shell varies in colour pattern, and *Papillifera papillaris* which has a characteristic spindle-shaped shell. Another snail also with a spindle-shaped shell is *Lampedusa syracusana* which lives in narrow cracks in rocks in garigue habitats. On the trunks of trees, in deep shade, is found the snail *Murella melitensis* which is easily recognised by its characteristically marked shell. *Cernuella caruanae* is found on the stems of carline thistle on patches of open uncultivated land. The ubiquitous roman snail (*Helix aspersa*) also occurs at Buskett as do a number of other very small species.

can also be found in spring. Among the ants are nests of *Tapinoma erraticum* made up of particles and supported by the twigs of low bushes. Flying insects are few, mostly drone flies (*Eristalis tenax*) and honey bees (*Apis mellifera*). Other insects include grasshoppers like *Acrotylus patruelis* and the Egyptian locust (*Anacridium aegyptium*).

Covering the branches and stems of fig trees (*Ficus carica*) are the fig scale insect (*Icerya purcasi*). These insects cover themselves with a waxy substance exuded from their body, take the shape of scales, and spend their lives attached to plants sucking their juices.

(c) Wied l-Isqof (March)

Wied l-Isqof is one of the tributaries of the great Wied il-Kbir. The valley is fringed on one side with the great reed (*Arundo donax*), while the other side is lined by dry walls topped by prickly-pear (*Opuntia ficus-indica*). The flora of the disturbed ground includes such common species as the yellow cape sorrel (*Oxalis pes-caprae*), which is a native of South Africa, the blue-flowered borage (*Borago officinalis*) the attractive honeywort (*Cerinthe major*) with hanging bell-shaped flowers which are half cream and half brown, while the wild cabbage (*Brassica rapa* ssp. *sylvestris*) with bright yellow flowers, grows abundantly in the fields. The watercourse supports a characteristic vegetation with willow-herb (*Epilobium tetragonum*), clustered dock (*Rumex conglomeratus*) and fescue (*Festuca arundinacea* ssp. *mediterranea*). The side lined with dry walls used to support a large population of horsetail (*Equisetum ramosissimum*).

The wied supports rich animal life. The watercourse is the home of a large community of pond-snails (*Lymnaea truncatula*). One of the most unusual creatures found was a male horsehair worm (*Paragordius* sp.), which are several cm. long. The one seen was about 20 cm. long. Their larvae are parasites in various insects, the adults do not feed but sexually reproduce.

Insects were represented by a variety of Lepidoptera (butterflies and moths) such as the painted lady (*Cynthia cardui*), the large white (*Pieris brassicae*), and the humming-bird hawk-moth (*Macroglossa stellatarum*) which is one of the few moths which fly by day. Beetles included curious oil beetle (*Meloe* sp.). Hymenopterans (bees, wasps, ants) included paper-nest wasps (*Polistes* sp.) with their characteristic papery nests, large carpenter bee (*Xylocopa violacea*) with their black body and dark purple wings and large ant (*Camponotus*). Other animals included the painted frog

(b) Wied il-Girgenti (February)

The valley sides and bottoms support numerous trees and large shrubs such as white poplar (*Populus alba*), bay laurel (*Laurus nobilis*), large specimens of lentisk (*Pistacia lentiscus*) and myrtle (*Myrtus communis*). There are also numerous climbers and stragglers such as ivy (*Hedera helix*) and bramble (*Rubus ulmifolius*) and large herbs such as the very common alexander (*Smyrnum olusatrum*), often associated with the carob (*Ceratonia siliqua*), which is also very common here especially on the higher ground. Very large lobed leaves belong to the acanthus or bear's breeches (*Acanthus mollis*), while the arrow-shaped leaves accompanied by strange pipe-shaped "flowers" are those of friar's cowl arum (*Arisarum vulgare*).

The fields support numerous weedy species, especially white mustard (*Diplotaxis erucoides*) and bargeman's cabbage (*Brassica rapa ssp. sylvestris*). Ubiquitous species include cape sorrel (*Oxalis pes-caprae*), wild marigold (*Calendula arvensis*) and snapdragon (*Antirrhinum tortuosum*). There is a garigue community, dominated by evergreen, hard-leaved, low shrubs growing on rocky ground, here mainly wild thyme (*Thymus capitatus*), yellow and olive-leaved germanders (*Teucrium flavum* and *Teucrium fruticans*), rue (*Ruta chalepensis*), shrubby kidney-vetch (*Anthyllis hermanniae*), buckthorn (*Rhamnus oleoides*) and Mediterranean heath (*Erica multiflora*). Numerous herbs cover the soil, including several bulbous types such as asphodel (*Asphodelus aestivus*) and seaside squill (*Urginea panceration*). The brown orchid (*Ophrys fusca*), is already in flower. Like other orchids of the genus *Ophrys* this has flowers that resemble insects, which it attracts in order to pollinate it. Rain pools support an interesting flora, water crowfoot (*Ranunculus saniculaefolius*), water pepper (*Elatine macropoda*), horned pondweed (*Zannichellia palustris*) and starwort (*Callitriche truncata*). The conspicuous brownish gelatinous masses associated with the shallower pools are colonies of blue green alga (*Nostoc*). Maidenhair fern (*Adiantum capillus-veneris*) grows here too. On the rocky ground there are also several shrubby lichens of the genus *Cladonia* (*Cladonia rangiformis*, *Cladonia convoluta*). (Here also are other lichens and mosses.)

On ivy (*Hedera helix*) and bramble (*Rubus ulmifolius*) are oak eggar caterpillars (*Lasiocampa quercii*) and caterpillars of the Maltese tiger moth (*Phragmatobia fuliginosa*) can be seen live on the ground. Other caterpillars of moths belonging to the families Noctuidae and Geometridae

(*Discoglossus pictus*), moorish gecko (*Tarentola mauretanica*) basilica spider (*Cyrtophora citricola*) with its complex webs among the prickly pears, and earthworm (*Allolobophora sp.*).

(d) Qirda (near Zebbug) (April, last vegetation paragraphs October)

Wied Qirda was one of the richest valleys but has now become much degraded due to various forms of human interference.

Numerous species of plants encountered in disturbed places are found here. To single out just a few of the commonest; crown daisy (*Chrysanthemum coronarium*) with its large yellow flower-heads, borage (*Borago officinalis*) with blue flowers and large leaves with stiff hairs, the closely-related honeywort (*Cerinthe major*) with drooping tubular flowers half white and half dark-brown, white mustard (*Diplotaxis erucoides*) with white four-petalled flowers, and the closely-related wild radish (*Raphanus raphanistrum*) in which the four white petals are finely veined in purple. In addition to these species, there are many common plants which are widespread over much of the countryside such as the common bird's-foot-trefoil (*Lotus ornithopodioides*) with yellow flowers in threes to fives; pitch clover (*Psoralea bituminosa*) with groups of purple and dark green trefoil leaves, and white clover (*Trifolium nigrescens*) with small dense groups of white flowers, as well as several grasses, especially the species of wild oats (*Avena barbata* and *Avena sterilis*), bromes (*Bromus diandrus*, *Bromus madritensis* and *Bromus hordaceus*) and hare's-tail-grass (*Lagurus ovatus*) with its decorative fluffy flower-heads. Many of the crown daisies are parasitized by the broomrape (*Orobanche pubescens*) which obtains all its nourishment from its host-plant and as a result has lost all trace of green chlorophyll the means by which normal plants make up their food.

A temporary flow occurs with heavy rain and this is marked by the presence of a number of plants characteristic of freshwater marsh habitats, such as cut-leaved cranebill (*Geranium dissectum*), dock (*Rumex spp.*), creeping cinquefoil (*Potentilla reptans*) and large-leaved buttercup (*Ranunculus macrophyllus*). The rock sides harbour several shrubs such as Mediterranean heath (*Erica multiflora*), buckthorn (*Rhamnus oleoides*), olive-leaved germander (*Teucrium fruticans*) and the Maltese fleabane (*Chiliandenus bocconeii*) in its winter foliage. Moist regions encourage the growth of maidenhair fern (*Adiantum capillus-veneris*), while at the base of the steep cliff sides are thickets of bramble (*Rubus ulmifolius*). Of greater interest is an area supporting a maquis habitat. The maquis is a

typical Mediterranean habitat which consists of small evergreen trees, shrubs, climbers, clamberers and lianes. Much of the Maltese maquis is semi-artificial, including several trees of cultivated origin. This particular maquis includes carob (*Ceratonia siliqua*), olive (*Olea europaea*), fig (*Ficus carica*), bay laurel (*Lauris nobilis*) and wych elm (*Ulmus glabra*). Clearings support a population of the lesser reed (*Arundo plinii*) while the great reed (*Arundo donax*) is colonizing the valley bottom. The undergrowth includes bramble (*Rubus ulmifolius*) and the large leaves of bear's breeches (*Acanthus mollis*). Along the valley there is also the clustered dock (*Rumex conglomeratus*) of which the dried fruit-clusters can be seen.

The rocky valley sides support a form of cliff flora with abundant capers (*Capparis orientalis*), Maltese savory (*Micromeria microphylla*), Mediterranean heath (*Erica multiflora*), and Maltese fleabane (*Chiliandenus bocconeii*). In the shadier, moister spots, maidenhair fern (*Adiantum capillus-veneris*) is also found. Butterflies include small heath (*Coenonympha pamphylus*), large and small white (*Pieris brassicae* and *Artogeia rapae*), speckled wood (*Pararge aegeria*) and small blue (*Polyommatus icarus*). Rusty-red potter bees (*Chalicodoma sicula*) collect mud to construct their nests, while another bee, (*Osmia rufa*) with a bright red hairy abdomen, occurs in large numbers around flowers. Of interest is a syrphid fly, (*Medon rufus*), which mimics *Osmia rufa*. This is a device to protect it from the attentions of insectivorous birds. Another interesting fly is the drone-fly (*Eristalis tenax*) which mimics honey-bees and is also common here. The flowers of the crown daisy provide a habitat for several kinds of beetles as well as for crab-spiders, of which *Synema globosum* with yellow or red abdomen is common here. Land-snails include sandhill snail (*Theba pisana*), striped snail (*Eobania vermiculata*), garden snail (*Helix aspersa*), while on the rocks are the tiny *Rupestrella philippi* as well as door-snails (*Lampedusa syracusana* and *Papillifera papillaris*) distinguished by their narrow spindle-shaped shells.

3. Wied Anglu (January)

Wied Anglu is one of the most beautiful of its kind. It is a refuge for a large number of plants typical of the old Maltese maquis which is now largely destroyed and includes some extremely rare plants. There is a group of carob trees (*Ceratonia siliqua*) with an undergrowth of the beautiful large-leaved bear's breeches (*Acanthus mollis*) and Italian lords and ladies (*Arum italicum*). The rocky ground supports a large variety of shrubs.

Among these is sage (*Phlomis fruticosa*), olive germander (*Teucrium fruticans*), Mediterranean heath (*Erica multiflora*), olive buckthorn (*Rhamnus oleioides*), tree spurge (*Euphorbia dendroides*), and hawthorn (*Crataegus monogyna*). At the bottom of the valley is dogbane (*Anagallis foetida*). Climbing plants include the bramble (*Rubus ulmifolius*), which fills much of the valley bottom (a sign of environmental degradation), thorny asparagus (*Asparagus acutellus*), honeysuckle (*Lonicera implexa*), wild madder (*Rubia perigrina*), and smilax (*Smilax aspera*) as well as the uncommon and very attractive Mediterranean traveller's joy (*Clematis cirrhosa*) with greenish-white flowers with four petals. The "Jewel" of Wied Anglu is the evergreen rose (*Rosa sempervirens*). It is a climbing plant with shiny leaves and white flowers followed by red hips.

In the open spaces there are Portuguese wood-daisies (*Bellis sylvestris*) with white rosy-tinged flower heads, tuberous hawkbeard (*Leontodon tuberosus*) with dandelion-like flowerheads the small white-flowered annual daisy (*Bellis annua*), asphodel (*Asphodelus aestivus*), and the large leaves of seaside squill (*Urginea panchratium*). Narcissus (*Narcissus tazetta*) is (even in winter) likely to bear only leaves due to the deplorable habit of the wholesale removal of the flowers for sale. In small cavities and crannies in the rock is Maltese fleabane (*Chiliandenus bocconeii*) and stonecrop (*Sedum sediforme*) with fleshy leaves.

The fauna include a variety of land snails, e.g. terrace snail (*Murella melitensis*) with its porcelain-like texture bearing a delicate light brown pattern, white snail (*Sphincterochila candidissima*) which is common in dry places close to the sea, Maltese land-whelk (*Pomatias sulcatus melitense*), door-snail (*Lampedusa macrostoma* and similar *Papillifera papillaris* and, Maltese top-snail (*Trochoidea calcarata*) and large banded snail (*Eobania vermiculata*) which exist in several patterns. Of special interest is the uncommon *Rupestrella philippi* which is only found on vertical lower Coralline walls shaded from the sun. The chamaeleon (*Chamaeleo chamaeleon*) is frequent here.

Contrasted to the great beauty of this wied is the damage caused by many forms of human interference. A huge quarry eats away at the south west, while the north east is submerged under rubble from the building sites, and planted over with blue wattle (*Acacia cyanophylla*). Selfish people have dumped all manner of refuse. The caves, once difficult access, are now just by a new road that has defaced the cliff. As a result, many people hold barbeques and other activities in the caves, and leave behind plastic bottles, used toilet paper, fruit juice cartons, charcoal, grills,

cigarette boxes and stubs, tin cans, etc. Unless such abuse is controlled, there will soon be no natural environment to speak of.

4. Wied Babu (March) (see also Chapter 13)

Wied Babu is a fairly typical "dry" valley in which water flows only for a limited period during the year. The valley also harbours trees and shrubs so the animal life is a mixture of valley species and others associated with woodland. The heavy foliage of the trees and shrubs on the valley floor and the steep narrow sides of the valley limit the amount of direct sunlight reaching the soil.

Apart from its great scenic charm, Wied Babu is also a gem of unique plant communities. The upper part of the valley bottom is a rich maquis community. In Malta, most of the maquis is limited to valley sides and valley bottoms. The Wied Babu maquis is very rich in species. The shrubs include two kinds of hawthorn (*Crataegus monogyna* and *Crataegus azarolus*), rosemary (*Rosmarinus officinalis*), olive (*Olea europaea*), carob (*Ceratonia siliqua*), lentisk (*Pistacia lentiscus*) and honeysuckle (*Lonicera implexa*). Important undergrowth plants are bramble (*Rubus ulmifolius*), clematis (*Clematis cirrhosa*), and the large leaves of the acanthus (*Acanthus mollis*).

The upper sides of the valley form a garigue community dominated by lower shrubs on rocky ground. The garigue, in spite of its arid appearance, is very rich in species and apart from the shrubs (such as Mediterranean heath (*Erica multiflora*), and Mediterranean thyme (*Thymus capitatus*), numerous bulbous plants and annuals appear in spring. Among the most interesting of the bulbous plants are the orchids.

Further down the valley the maquis gives way to a sloping garigue, clinging to the rocky sides. Most conspicuous in spring is crown vetch (*Coronilla valentina*), a shrub with bright yellow fragrant flowers.

There are numerous shrubs, including Maltese spurge (*Euphorbia melitensis*), and Maltese centaury (*Palaeocyanus crassifolius*) which in 1971 was declared the "National plant of Malta". It is easily recognised by its fleshy, bright green leaves, and is a survival from pre-Ice-Age flora. The low shrub with grey hairy aromatic leaves is the Maltese flea bane (*Chiliadenus bocconei*), and shrub with small grey leaves and bright yellow flowers, Egyptian St John's wort (*Hypericum aegypticum*), is essentially a north African species.

The most abundant and conspicuous insects are flies (Order *Diptera*).

Especially common are the *Bibionidae*, black hairy flies commonly called March flies, which are thought to play a part in pollinating flowers. These flies collect on the flower heads of the umbellifer *Smyrniolus olusatrum*. Also common on these flowers are hover-flies (family *Syrphidae*), amongst the most striking of the *Diptera* because of their bright colours and hovering ability. One species (*Medon rufus*), is interesting in having the body covered with red erect pubescence except for the head and wings which are black. This hover-fly mimics the mason bee (*Calicodoma sicula*).

Bees (Order *Hymenoptera*), are also common (spring and summer species). *Calicodoma sicula* typically has a red and black pubescence. This bee builds very hard compact nests of sand or soil particles cemented together usually on flat, south-facing rock faces. Other species include several small (*Halictus*) bees, frequent on many flowers. These bees build their nests in hollow trees and in the spaces between the stones of dry walls. The large black carpenter bee (*Xylocopa violacea*) nests in wood into which it drills holes with its powerful mandibles.

Butterflies (Order *Lepidoptera*) include small heath (*Coenonympha pamphilus*), whites (*Pieris brassicae* and *P. rapae*) and the occasional cleopatra butterfly (*Gonepteryx cleopatra*) whose larva feeds on buckthorn (*Rhamnus* spp.).

Beetles (Order *Coleoptera*) are well represented, especially by two small chafers very abundant on flower heads. These are *Tropinota squalida* and *Oxythyrea funesta*.

Harvester ants (*Messor* spp. and *Acantholepis*) occur on open ground. Harvester ants are immediately recognised because some of the workers are large insects with massive heads. Ants of the genera *Lasius* and *Crematogaster* associate with trees.

5. Bahrija Valley (June) (and see Chapter 13)

The Bahrija valley supports one of the few remaining permanent springs in the Maltese Islands, with plants and animals which require a supply of water all the year round. Since there are very few such habitats it means that many of the species which exist here are rare and vulnerable.

Most of the plants which grow in and along the streams possess extensive underground systems (roots/rhizomes) in order to support them in the unstable mud. Among the more characteristic plants are the great reed (*Arundo donax*) which occurs in many watercourses. Another notable plant is willow-leaved knotgrass (*Polygonum salicifolium*) which, though

abundant here, is very rare elsewhere. There is also fool's parsley (*Apium nodiflorum*) and water cress (*Nasturtium officinale*), which again are to be found along most watercourses. Also along the valley large clumps of calla lily (*Zantedeschia aethiopica*), a native of southern Africa which has become naturalised, and round-headed club-rush (*Scirpoides holoschoenus*), with tall tough cylindrical stems crowned by a cluster of globular heads. Another plant of note is the great plantain (*Plantago major*), with a large rosette of wide basal leaves and spikes of greenish flowers.

The most notable animal of the Bahrija valley is the freshwater crab (*Potamon fluviatilis lanbauoi*) which is only found in permanent springs. It is in fact a land crab dependent on a constant supply of water since it actually spends most of its time out of water. The crabs dig deep burrows in the soil along the stream, a part of the burrow being partly flooded to enable the crab to moisten its gills. They often find shelter under stones. The freshwater crab is a carnivore feeding on frogs, insects and dead remains of various animals. They often fight each other and many crabs are mutilated. The freshwater crab is often persecuted and wantonly killed. Another, more familiar, animal is the painted frog (*Discoglossus pictus*), which is common wherever water is present. This too is a persecuted creature and it is due to its remarkable resilience that it has not been wiped out of the Islands.

On the vertical walls of soil along the valley may be doors which lead to the burrows of trapdoor spiders (*Nemesia* sp.). This rare spider stays just under the door and when an insect walks over the door, the spider darts out and catches it. Other animals include dragonflies, damselflies, bugs, beetles and butterflies.

6. Wied il-Faham (first paragraphs January; chameleon, June; crypto fauna February) (see also Chapter 13)

Wied il-Faham is crossed by the Victoria Lines of which it forms part of the easternmost limit. Along the path leading down to the valley are the plants which tend to occur in more disturbed areas. Examples include the yellow crown daisy (*Chrysanthemum coronarium*), cape sorrel (*Oxalis pes-caprae*), white wall rocket (*Diplotaxis eruroides*), fennel (*Foeniculum vulgare*) and blue flowered borage (*Borago officinalis*).

On the rocky ground the dominant vegetation consists of dwarf shrubs such as Mediterranean thyme (*Thymus capitatus*) and yellow germander (*Teucrium flavum*), accompanied by a variety of sub-shrubs such as

squinnancywort (*Asperula aristata*), Maltese savory (*Micromeria microphylla*), which is used in folk medicine as a remedy for kidney stones, and Maltese fleabane (*Chiliadenus bocconei*) with aromatic leaves. Numerous bulbous and tuberous plants also occur, e.g. the dandelion-like tuberous hawkbeard (*Leontodon tuberosus*). Mosses include species of thread-moss (*Bryum*), screw moss (*Tortula*, *Tortella*) and cord moss (*Funaria*) as well as numerous liverworts (Hepatics) such as species of crystalwort (*Riccia*), frilled scale-moss (*Fossombronia*), short-fruited liverwort (*Targionia hypophylla* and *Petalophyllum ralfsi*). The numerous lichens are represented by black encrustations of *Verrucaria* and by orange encrustations of *Caloplaca* on rock while on the soil which accumulates in hollows of rocks is the "shrubby" *Cladonia pocillum* with trumpet-shaped reproductive structures, and *Cladonia convoluta* as well as the flattened olive-green *Lecidea decipiens* and *Dermatocarpon*. Gelatinous species of *Collema* are also common, while large gelatinous masses on the soil are the blue-green alga *Nostoc*. Tooth-leaved clubmoss (*Selaginella denticulata*), which is the only clubmoss in the Maltese Islands, occurs here.

The bottom of the valley is dominated by small trees and large shrubs such as carob (*Ceratonia siliqua*), lentisk (*Pistacia lentiscus*), buckthorn (*Rhamnus oleoides*), hawthorn (*Crataegus monogyna*) and climbers such as bramble (*Rubus ulmifolius*), and travellers joy (*Clematis cirrhosa*). The undergrowth includes two rarities: birthwort (*Aristolochia clusii*) and southern sedge (*Carex halleriana*).

The rocky sides of the valley provide a vista of great scenic beauty, dominated by medium-sized shrubs such as tree spurge (*Euphorbia dendroides*), Mediterranean heath (*Erica multiflora*), and great sage (*Phlomis fruticosa*).

The chameleon (*Chamaeleo chamaeleon*) was imported in the 1820s and has managed to establish itself. It has now become well integrated with the Maltese countryside. It is no longer exclusively arboreal (tree-living) as it is in its native haunts, and can often be seen on rocky ground.

Crypto fauna means 'Hidden Animals' and refers to those invertebrates which are found dwelling beneath stones, rotten logs and in similar dark and damp situations. Wied il-Faham provides habitats for e.g. the black slug (*Milax* spp.), and a smaller brown slug (*Deroceras* and *Papillifera papillaris*, recognised by its spindle-shaped shell). Rainwater washes out empty shells and large deposits of these are found all over the valley. (Other shells are of: *Lampedusa syracusana*, *Ferrussacia folliculus*, *Chondrula pupa* and *Rumina decollata*.)

Woodlice scuttle away as soon as they are exposed to light. Over forty species occur in the Maltese Islands. The largest at Wied il-Faham are *Armadillidium* sp. which roll up into a ball for protection, and the slate-grey *Porcellio* sp. which are larger but not able to roll up. A millipede (*Glomeris*), which is able to roll up into a small ball, also occurs. Other millipedes and centipedes live here too. Centipedes have one pair of legs per segment while millipedes have two.

Scorpions (*Euscorpius carpathicus*), pseudo-scorpions, which look like tiny tailless scorpions but are not actually closely related, spiders, many of which build a simple funnel-shaped web under stones, and several insects, amongst them the primitive silverfish, may be found.

7. Wied Gerzuma (April)

Down the sides of Wied Gerzuma, Upper Coralline changes to Blue-Clay taluses, part of which are terraced and cultivated, and then to *Globigerina* limestone. There is a very narrow stratum (the upper phosphorite pebble-bed) which separates the upper from the middle *Globigerina* limestone. Here there are phosphorite pebbles and numerous fossils in the pebble-bed, and the different colours, texture and weathering properties of the two kinds of *Globigerina* each side of the pebble-bed show well.

The vegetation of the upper eastern part of the valley is mainly of the garigue type. The slopes support a very degraded maquis, in which carob (*Ceratonia siliqua*) is prominent, with honeysuckle (*Lonicera implexa*), climbers and straggling plants such as smilax (*Smilax aspera*) and spiny asparagus (*Asparagus aphyllus*). Deeper into the valley is myrtle (*Myrtus communis*) and the grass *Ampelodesma mauritanica*. Going down the clay slopes, nearer to the sea the vegetation becomes more interesting. The clays are dominated by sulla (*Hedysarum coronarium*) and esparto grass (*Lygeum spartium*) forming tufts of wiry leaves. The more rocky coastal areas are dominated by Maltese salt-shrub (*Salsola melitensis*) and sea lavender (*Limonium* sp.). Maltese sea chamomile (*Anthemis urvilleana*) and Maltese fleabane (*Chiliandenus bocconeii*) are also frequent.

In a reservoir are submerged stoneworts (*Chara* sp.), a peculiar and large group of fresh water algae. There is also a clump of bulrush (*Typha domingensis*). Around it are some rush (*Juncus subulatus*), toad-rush (*J. hybridus*), loosestrife (*Lythrum junceum*) and sea barley (*Hordeum marinum*).

Many species of flies (*Diptera*) and bees (*Hymenoptera*, *Apoidea*), too

numerous to list here, visit the flowers. On large flower heads, particularly of Compositae and Umbelliferae, various small beetles (*Coleoptera*), bugs (*Hemiptera* and *Homoptera*) and other small insects may be found.

Other conspicuous insects visiting flowers are butterflies (*Lepidoptera*, *Popilionoidea*), e.g. small heath (*Coenonympha pomphilus*), common blue (*Polyommatus icarus zelleri*), clouded yellow (*Colias crocea*), large white (*Pieris brassicae*) and Maltese swallowtail (*Papilio machaon melitensis*).

On sulla (*Hedysarum coronarium*) are found the nymphs of long grasshopper (*Platycleis intermedia*), while adult Egyptian locust (*Anacridium aegyptiacum*) rest on dry walls and small shrubs. On the ground live the wingless cockroach (*Loxoptera decipiens*) and occasional large beetles such as the scarabid (*Pontodon punctatus*) and the devil's coach horse (*Staphylinus olens*). Near the reservoirs are, in spring, the emperor dragonfly (*Anax imperator*), damselflies (*Ischnura genei*) courting over the water, and mayfly (*Cleon dipterum*), all of which have aquatic larvae.

8. Wied Has-Saptan (October) (see also Appendix 2)

Wied Has-Saptan is mostly cut in Lower Coralline limestone, with a capping of Lower *Globigerina* limestone on the ridge along the valley sides. At the coast the wied is wide and gentle, but inland the sides become steeper, and the valley narrower.

Trees and shrubs grow in abundance and include carob (*Ceratonia siliqua*), which is now in flower (and note how male and female flowers are borne by separate trees), fig (*Ficus carica*), almond (*Prunus amygdalus*) and olive (*Olea europaea*). Shrubs include buckthorn (*Rhamnus oleoides*), lentisk (*Pistacia lentiscus*), Mediterranean heath (*Erica multiflora*) two species of germander (*Teucrium fruticans* and *T. flavum*). Deeper in the valley is a small grove of wild pear (*Pyrus amygdaliformis*).

Soon after the first rains, there are still the last of the autumn flowering bulbs. These are autumnal squill (*Scilla autumnalis*), lesser narcissus (*Narcissus serotinus*), autumnal grape hyacinth (*Muscari parviflorum*) and arrow grass (*Triglochin laxiflorum*). Seaside squill (*Urginea panchration*), flowers in late August/September and its wide leaves appear on huge bulbs.

Another plant in flower is fleabane which grows in both natural and disturbed localities (*Dittirichia viscosa*). Some of the flower-heads are swollen by galls (tumours in plants caused by a variety of organisms)

produced by a tiny wasp (*Myopites olivieri*), the gall serving to protect and provide food for the wasp larvae. Another fleabane is *Chiliadenus bocconei*, which smells strongly of camphor and grows on the rocky ground.

Wied Has-Saptan also supports a rich flora of non-flowering plants. On the cool moist rocks at the bottom of the valley are a variety of mosses and liverworts as well as two species of ferns: the Jersey fern (*Anogramma leptophylla*), and the commoner maidenhair fern (*Adiantum capillus-veneris*). Several species of lichen(s) grow on tree trunks and rocks.

Very conspicuous because of their large size are the dragonflies which in autumn can be seen flying around hunting prey, courting and mating. Those individuals seen alighting close to rock-pools are probably laying their eggs. The last broods before winter of a number of species of butterflies may also be seen. The main species are Maltese swallowtail (*Papilio machaon melitensis*), red admiral (*Vanessa atalanta*), common blue (*Polyommatus icarus*) and skipper (*Gegenes pumilio*). An interesting butterfly observed on a recent visit was the clouded yellow (*Colias crocea*), which migrates at this time of year. The pale female form (var. *helice*) of this species was also observed.

The most commonly observed insects will probably be grasshoppers e.g. *Euprepocnemis plorans*, *Sphingonotus coerulens*, *Calliptamus barbarus* and others. Other insects are carpenter bees (*Xylocopa violacea*), 'Dor' beetles (*Geotrupes intermedius*), and scarabs (*Antheus variolosus*). Various species of moths, mainly of the families Noctuidae and Geometridae rest on vegetation.

The numerous rock-pools, when full of rain-water, harbour numerous animals, the most conspicuous of which are the larvae of mosquitoes (*Culex* spp.). The most interesting freshwater animal to be found here is the fairy shrimp (*Bronchialus* sp.), a primitive crustacean which swims on its back.

Two species of snake were observed: the black whip snake (*Coluber viridiflavus carbonarius*), and the rarer cat snake (*Telescopius fallax*).

9. Wied Migra Ferha (November)

A ravine drains the water from the valley. Around the ravine and festooning its sides is the Maltese cliff orache (*Cremnophyton lanfrancoi*) a white-leaved shrub. Accompanying the cliff-orache is the Maltese salt-tree (*Darniella melitensis*) and the shrubby glasswort (*Arthrocnemum glaucum*). On the Lower Coralline Limestone rocky cliff-top is a large population of Maltese sea-lavender (*Limonium melitensis*) together with Maltese

sea camomile (*Anthemis urvilleana*) which has recently germinated, together with the slender crystal-plant (*Mesembryanthemum crystallinum*). On the edge of the cliff are populations of the shrubby St John's wort (*Hypericum aegypticum*), rock crosswort (*Crucianella rupestris*), both of which have eastern North African affinities, as well as the sea samphire (*Crithmum maritimum*), golden samphire (*Dittichia crithmoides*), with shrubby bird's foot trefoil (*Lotus cytisoides*), and cliff carrot (*Daucus rupestris*). Among the common plants one may single out the dwarf wall rocket (*Diplotaxis viminea*) and sweet alison (*Lobularia maritima*). Between the cliffs and the higher ground there is a large population of the clay-loving esparto-grass (*Lygeum spartum*).

Further along hanging right under the ledge of the cliff is a small colony of Malta's national plant, the Maltese rock-centaury, (*Palaeocyanus crassifolius*). Inland there is some Mediterranean thyme (*Thymus capitatus*) as well as common plants such as white wall-rocket (*Diplotaxis erucoides*), and field marigold (*Calendula arvensis*).

The animal life of Migra Ferha is of great importance also.

10. Mistra Valley (October) (see also Appendix 2)

Along the lower Mistra watercourse, the most obvious plants are the introduced eucalypt trees (*Eucalyptus camaldulensis*). Eucalypt is all right lining a street, or in some previously ruined habitat, but it is definitely out of place in a wied. Apart from these trees, the valley is dominated by great reed (*Arundo donax*) and round-headed club-rush (*Scirpoides holoschoenus*), as well as brambles (*Rubus ulmifolius*). Viscous fleabane (*Dittrichia viscosa*) and squirting cucumber (*Ecballium elaterium*) mark the more disturbed areas. In various parts of the valley, as well as in the maquis, we also see the flower-heads of ground thistle (*Atractylis gummifera*) which are unusual in that the flowers appear before the leaves. This plant has a thick tuberous root which is highly poisonous. The watercourse along the Mistra valley has been degraded in recent years by the blocking of the spring which used to feed the valley. This has resulted in considerable impoverishment of the vegetation.

Approaching the seaside, those plants which are typical of maritime habitats increase. Great reed (*Arundo donax*) is replaced by the common reed (*Phragmites australis*). Golden samphire (*Dittichia crithmoides*) and saltwort (*Salsola soda*) also occur. Both have fleshy leaves in order to store water. In salty conditions plants find it difficult to absorb water from the

soil. Also common close to the sea are spear-leaved orache (*Atriplex prostrata*) and bermuda grass (*Cynodon dactylon*) (which is common in many other habitats and is used in seed mixtures for lawns).

On the eastern side of the opening of the Mistra valley there is a hillside maquis which is somewhat degraded and merges in several parts to what would be considered a garigue. The dominant shrubs in the maquis include olive-leaved privet buckthorn (*Rhamnus oleoides*), honeysuckle (*Lonicera implexa*) and olive (*Olea europaea*). Further up the hill, in an area which has been largely afforested artificially, there are also numerous shrubs of the uncommon wolfbane (*Periploca angustifolia*) with its characteristic horn-shaped fruits. Aleppo pines (*Pinus halepensis*) have been planted. In this case this is a wise choice of trees since this pine is a native of the Maltese Islands and was probably part of the original vegetation before it became degraded due to human interference. The undergrowth and more open parts of the maquis are occupied by shrubs such as Mediterranean wild-thyme (*Thymus capitatus*), yellow germander (*Teucrium flavum*), Mediterranean heath (*Erica multiflora*), and grasses such as cockscomb (*Dactylis glomerata*). Under trees and shrubs and supported by them and the rocks are various climbers and clamberers such as smilax (*Smilax aspera*), madder (*Rubia peregrina*) and spiny asparagus (*Asparagus aphyllus*).

In the deep ravines are smilax and black bryony (*Tamus communis*). On the exposed ground is stonecrop (*Sedum sediforme*) and Maltese fleabane (*Chiliadenus bocconei*). In crevices of the rocks are also numerous mosses and lichens. Of the mosses the most prominent are *Cladonia* species represented here by *Cladonia convulata* and *Cladonia rangiformis*. Lichens are actually "double plants" composed of a fungus and an alga which live in an intimate and mutually beneficial union. The afforested area is dominated by blue wattle or acacia (*Acacia cyanophylla*), a native of Australia, and cypress (*Cupressus sempervirens*). Cypress is a Mediterranean native. Blue wattle is objectionable as being exotic.

Several species of butterfly are found here, including swallowtail (*Papilio machaon melitensis*), meadow brown (*Maniola jurtina hyperhispulla*), wall brown (*Lasiommata megera*), and large (cabbage) white (*Pieris rapae*). Also prominent are harvest ants (*Messor* sp.). Land snails include the ubiquitous garden snail (*Helix aspersa*), sandhill snail (*Theba pisana*), carnivorous snail (*Oxychilus draparnaudii*), door-snails (*Papillifera papillaris* and *Lampedusa syracusana*), pointed snail (*Cochlicella acuta*) and top snail (*Trochoidea calcarata*).

It will be seen that the whole area has been infiltrated by development. This area was until recently relatively unspoilt but it is now sharing the fate of so many other Maltese natural beauty spots.

11. Wied Znuber (April)

Wied Znuber is formed in Lower Coralline Limestone which, being a relatively hard rock, is quite resistant to erosion and develops a characteristic topography consisting of sheer cut cliffs. This is evident both at the mouth of the valley where the cliffs plunge into the sea and at the valley sides which are very steep. The plateau develops a typical karst landscape. The edges of Wied Znuber are terraced but the sides rapidly become steep and in parts almost vertical.

The rocky ground above the valley supports a typical seaside garigue type of vegetation. Among the shrubs are Mediterranean heath (*Erica multiflora*, *Prasium majus*), olive-leaved germander (*Teucrium fruticans*) and sea ragwort (*Senecio cineraria*). An interesting shrub is Egyptian St John's wort (*Hypericum aegypticum*), of essentially North African distribution. Smaller or less compact shrubs include stonecrop (*Sedum sediforme*) with succulent leaves, a shrubby birdsfoot trefoil (*Lotus cytisoides*), pine spurge (*Euphorbia pinea*) and the pitch clover (*Psoralea bituminosa*). Many plants with underground storage organs are also to be found in the garigue and these include seaside squill (*Urginea panceration*), tassel hyacinth (*Muscari comosum*), hairy garlic (*Allium subhirsutum*), and corn flag (*Gladiolus italicus*) in the more sheltered places. This species is essentially a plant of cornfields, and its presence outside these often marks localities which were previously under cultivation. In some places the garigue is somewhat degraded and here one of the dominant plants is asphodel (*Asphodelus aestivus*). Many asphodels have leaves parasitized by dodder (*Cuscuta epithymum*), which looks like a tangle of red threads growing on the leaves. Dodder is a flowering plant which has lost its ability to photosynthesize and hence depends for all its nourishment on its host. Among the annual plants which grow among the shrubs are the edible birdsfoot trefoil (*Lotus edulis*), blue pimpernel (*Anagallis arvensis*), and cleavers (*Galium aparine*). Further down the valley the vegetation becomes more shrub-like, being dominated by small trees such as carob (*Ceratonia siliqua*), lentisk (*Pistacia lentiscus*), and hawthorn (*Crataegus monogyna*). The undergrowth includes bears breeches (*Acanthus mollis*), lords and ladies (*Arum italicum*), honeywort (*Cerinthe major*) and herb

robert (*Geranium purpureum*) as well as the ubiquitous cape sorrel (*Oxalis pes-caprae*) many plants of which are parasitized by a small broomrape (*Orobancha nana*), the flowers of which may be white or purple. Deep in the valley there is a dense growth of great reed (*Arundo donax*) and bramble (*Rubus ulmifolius*).

April being the last month when temperature and humidity are favourable to plant growth, many garigue and steppe plants are in flower and consequently numerous insects will be visiting these (unless it is too windy). Apart from butterflies, other insects in evidence include many different types of fly such as hoverflies (*Syrphidae*, especially the large species *Eristalis tenax*), bee-flies (*Bombiliidae*) and others of the families Tachinidae and Muscidae. Bees and beetles also visit flowers. Apart from the ubiquitous Honeybee (*Apis mellifera*) the former also include bees of the families Andrenidae and Halictidae, while amongst the latter are the metallic green beetle (*Psilothrix cyaneus*), the hairy beetle (*Tropinota squalida*) and crane fly (*Drilus flavescens*) which has yellow-brown wings. In the undergrowth are crane-flies (*Tipula* sp.), which are slender long-legged flies looking rather like overgrown gnats and Egyptian locust (*Anacridium aegyptium*). Also on the undergrowth there may be frothy masses of cuckoo-spit produced by the nymph of a frog hopper (*Philaenus* sp., a member of the Homoptera) by forcing air into a fluid exuded from the anus. The froth protects the nymph from drying up and probably also from predators.

Particularly interesting are those animals whose normal habitat is the steep valley sides. Clinging to the bare rock are found minute snails (3-4 mm) dark brown or almost black in colour. These are *Rupestrella philippi*. In cracks or holes in the rock another species occurs, the door snail (*Lampedusa syracusana*). At the base of the plants growing out of shallow pockets of soil in the valley walls is found yet another snail, (*Trochoidea calcarata*) immediately recognisable by its pyramidal shell. Trapdoor spiders usually dig their tubelike burrow in soil, but in the Maltese Islands one species (*Nemesia* sp.) builds its burrow in holes eroded in rock faces. The tube is built of silk and the entrance is closed by a bevelled lid (also made of silk), to the outer surface of which soil particles adhere, making the entrance perfectly camouflaged. The lid is held shut by the spider but the vibrations of passing prey cause the spider to rush out and capture the prey. A population of these trapdoor spiders lives at Wied Znuber on the steep rocky sides close to the valley bed. Silky globular masses sticking to the rock are not made by spiders but are the product of the female vapourer

moth (*Orgyia trigotephra*). The female is flightless and does not leave the larval cocoon. The male fertilises the female *in situ* and the female then lays the eggs in the cocoon. The eggs hatch in April/May so the cocoon seen then will either be empty or will contain the small white eggs.

HARVESTS FROM THE WIDIEN

The larger widien form a valuable source of income, though most crops can be found out of as well as within the widien.

Minerals

Quarrying is done inside as well as outside widien, in the *Globigerina* for the building industry, (e.g. spalls and sand in River Sewda, see Chapter 12), and in the Coralline for stone blocks, slabs etc., (e.g. in River Ghasel, see Chapter 12). Its disadvantages are discussed in Chapters 7 and 11. Only a little of the rubble dumped in widien will be removed for use.

Top soil is eroded from fields and uncultivated ground by storm flows, and is deposited on the watercourse beds. Soil is carried by water with much stream power (energy: the ability to lift and carry weights, which is given by the speed and quantity of moving water). More power is needed to carry gravel than silt. Consequently as water passes down flatter parts of rivers, it slows, and sediment drops out, first any gravel, then sand, then silt, the silt being carried much the furthest. Hence the deposited sediment may be soil, large particles deposited quickly after arrival in the river, sand, or silt, the most widespread. Traditionally sand deposited in widien by winter storms was collected by local householders, and used for mending roofs and repairs to buildings, etc. This continued within living memory, as in Attard.

Silt and soil were traditionally collected and replaced on the fields, to maintain the soil there for the crops. This is labour-intensive, and has effectively stopped. Hence the silting up of the impoundments and other places where flow is obstructed (above dams, some rocky outcrops etc.). Since it is not removed as useful, the sediment is left as useless, clogging water flow, smothering plants and animals, etc.

Animals

Grazing. Grazing is allowed on public land, which includes watercourse beds and (public) roadsides, and of course, farmers have grazing on their own land. For its advantages and disadvantages for conservation, see Chapter 16. Sheep and goats are the main grazing species, with the occasional mule, horse etc.

Rabbits. The wilder and rockier parts of widien, especially, make good homes for wild rabbits, and these can be cropped.

Birds. There are no wetland, aquatic or wied communities, as so many birds are shot or trapped when they arrive. Trees may be planted, encouraged or removed by hunters and trappers, and other vegetation managed likewise (see also Chapters 10 and 16).

Bee Keeping. Garigue with Mediterranean thyme (*Thymus capitatus*), gives very good honey, and other garigue and maquis types on rocky valley slopes are also satisfactory, as are various flowering field crops such as clover and broad bean.

Snails. These can be cropped (and over-cropped, see Chapter 10) from stony places and dry walls.

Plants

Crops include both irrigated (e.g. potatoes, orchard fruits, vegetables) and non-irrigated or not necessarily irrigated, (e.g. cereals, sulla, vine) woody (e.g. olive, vine, citrus, peach, loquat, plum), forage (e.g. sulla, green barley), grain (e.g. wheat), vegetables (e.g. artichokes, tomato, carrot) and fruit (e.g. strawberry) – in fact a good selection from the potential range in this Mediterranean climate. With so much food imported, the variety still grown is surprisingly great, and indigenous as well as imported crop strains exist. It is most important that these native strains be preserved, for their genes. Samples should be collected throughout the Islands, and kept (preventing interbreeding!) in some secure area (the new micropropagation unit will have a gene bank). This is of crucial importance. A slight change in economic or climatic pattern can mean the near-loss of any given crop, and the total consequent loss of native genes, so the loss

forever of these for their value in the development of future crops. For instance, a small fruited and sweet strawberry is now seen only in some agricultural shows.

The crops are determined by topography and water resources. The steepest, most rocky, and shallowest soil areas are uncultivated, and so are parts of the valley floors, and other fields recently abandoned.

Widiien with gnien areas may be well-watered by springs (and in the past certainly would have been). Well-watered land may also be found at riversides, and on valley floors where these are rain- or spring-fed much of the winter. Good gnien areas typically bear good orchard trees, and may be inter-cultivated (with another crop below). Lesser gnien areas may have clumps or bands of orchard trees. Citrus trees are typically along the spring line, peaches and plums by walls. Apple and pear need the most water. Pomegranate, loquat and almond (grafted) are also related to spring lines. Vines are on much of the best watered heavy Blue Clay slopes but also occur on unirrigated land. As well as using wided water already in place, water may be brought in for irrigation from rivers or springs or from further away, by bowser or by lengthy irrigation systems. These are increasing, as more land is coming under irrigation.

Carob and prickly pear are the commonest woody plants on drier ground, growing on walls, field edges etc., and prickly pear is also used for fencing. Carob is probably native: it is certainly in its general native range, though its present distribution is from planting, and many trees are grafted. Prickly pear is from tropical America. Both have fruit typically eaten by livestock when times are good, and by people, when they are bad. (The "locust" of the Bible, as eaten by St John the Baptist etc., is the carob or locust bean, not the grasshopper.) Both are often planted as much to break up rock and boulder as to provide fodder. The Health Industry's demand for carob as a substitute for chocolate has not yet affected Maltese cultivation, neither has the international trade of carob seed for the LBG (long bean gum) extract used so much in the food industry. Carob's syrup is however used for coughs, and sweets made from it are traditionally Good Friday delicacies. The Fig is another cultivated dryland tree.

Typical and representative farming patterns are shown in Figs. 4.1 and 4.2, which demonstrate the effect of rock type, topography, water resources and the variety of farm uses that have developed as a result of these. Crops may be on the valley floor or the slope, wherever there is space and enough soil; (soil native, or soil brought in; terraced or untterraced).

Compared with similar Mediterranean countries, vine and olive are noticeable by their sparsity. Both were abundant in the past and there



Fig. 4.1. Valley farming recent photographs).

(a) Marfa. Shallow Coralline valley, soil presumably brought in (so this was watered); gentle slope, garigue and little soil outside the valley floor; cross walls massive, retaining soil with considerable height on the steps.



(b) Wied Hanzira. Steep Coralline gorge with flat valley floor; little vegetation and soil on the gorge; a little rough goat grazing only (but to conserve the soil, grazing should be decreased); gorge winding with cross retaining walls, but floor is nearly flat; flow channel is narrow, intermittently with cross walls, dug out at side.

seems no reason, other than cultural wishes, why these two are not now main crops. Their cultivations has recently increased with commercial vineyards at Marnisi (Marsaxlokk) and at Ta' Qali, while olives are used in public afforestation.

In the watercourse itself, wetland plants may occur and be harvested. *Arundo donax*, a dampland rather than an aquatic plant, is the main harvested species (fences, screens, general tourist and farm use). This is discussed further in Chapters 10 and 16. More in the past (when they were more abundant) than now, tall wetland (monocot) plants like *Typha domingensis*, *Scirpus* spp., and *Cyperus* spp. were harvested, primarily for farm use.

(c) Wied Ghasel. Steep Coralline gorge with flat valley floor; gorge as in (b); field walls parallel to floor, not across it; erosion should be compared with the (b) type, and, if desirable, cross walls should be inserted to protect from severe occasional storms; channel 10 m or more wide, less disturbed than in (b).



d) Gnejna Valley. Deep but wide valley with shallow farmed slopes; Coralline capping to the hills, with clay slopes below; the slopes are mostly terraced with wide fields; valley floor sunk only slightly below the lowest terrace fields; the retaining cross walls bring only slight steps into the gently sloping valley floor; *Arundo donax* is cultivated as an additional cross barrier and is available for a narrow dug channel occurs at the side where the bed is wider; in the narrower part the bed is unfarmed (except for *Arundo*); note the "river bank" is the edge of the lowest terrace: once more the pattern is man-made.



Farming History (Including the Larger and More Non-gorge Wied Slopes)

Farming was present in the early Neolithic period (c.5000 BC) and barley, wheat (*Triticum dioicum* and *T. compactum*) and lentil were cultivated. Cattle, sheep, goats, pigs and olive and vine occurred before 3000 BC. By about 2600 BC, horse, deer, cat and dog had appeared, as well as hawthorn,

Table 4.1

Wied plant crops

Vegetables:

- (a) Roots, corms and tubers: potatoes, onions, carrots, garlic.
- (b) Brassicas: kohlrabi, cabbages, cauliflowers.
- (c) Others: gourds, pumpkins, long marrows, broad beans, runner beans, pears, tomatoes.

Fruits:

- (a) Cultivated forms: strawberries, melons, water melons, apricots, peaches, plums, pears (including the local small-fruited pear, bambinella), apples, grapes, oranges, lemons, tangerines.
- (b) Hardy fruits: olives, carobs, prickly pears, mulberries, figs, pomegranates.

Rotation crops:

Cereals and forage legumes are traditionally sown as rotation crops to vegetables such as potatoes and onions.

ash and the Judas tree. With the Bronze Age came a break in the sequence. Agriculture continued, and broad beans (*Vicia faba* var. *celtica*) appeared. Roofing timber was partly re-used from earlier periods (showing, as early as 1930 BC, that timber trees were in short supply).

Olive was abundant, pine present. Roman authors referred to the cotton cultivated here, and to the roses, palms, olives, vines, figs and other fruit trees. No shortage of water then! The Arabs cultivated much citrus, replacing olive and vine. The Knights of St John of Jerusalem cultivated cotton (and cumin) as export crops, importing grain and vegetable oil. The cotton market vanished around 1800 (with Egyptian cotton being both cheaper and more suited to the new machinery). Citrus, stone fruit, apples and pears were grown on a large scale after 1918 — each century has brought changes, but changes within a mixed farming pattern. In the nineteenth century, imported food was necessary, as to a yet greater degree

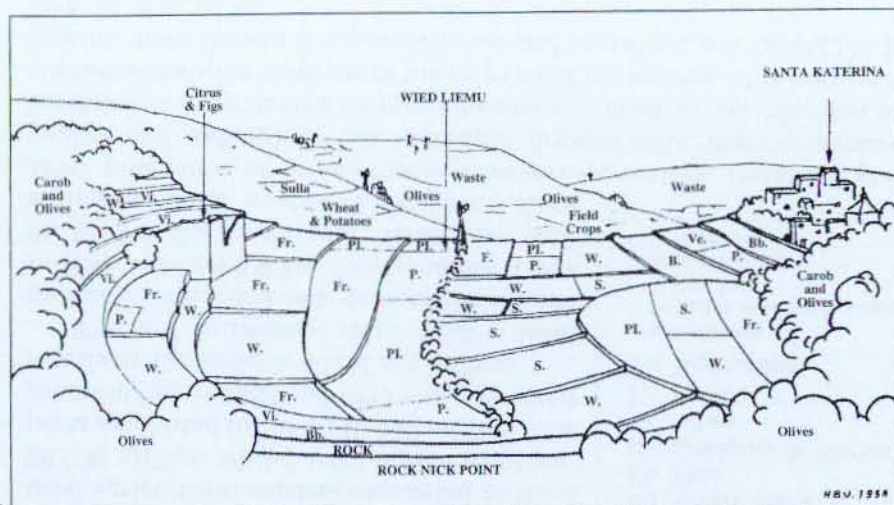
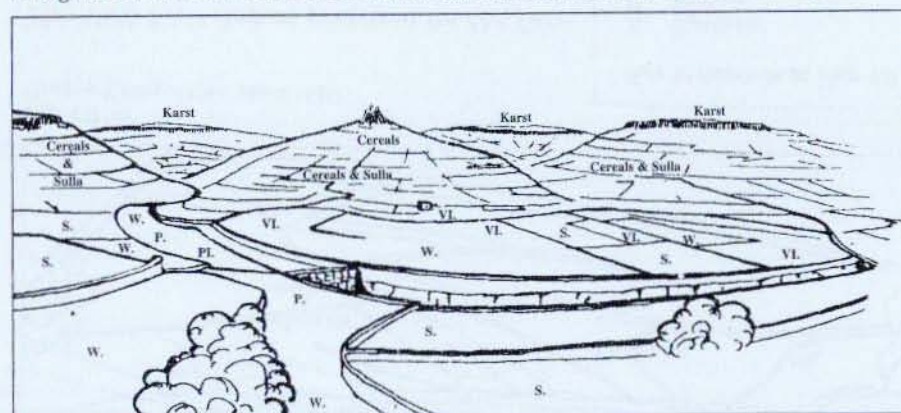


Fig. 4.2. Valley farming 1950s plans (Bowen Jones et al., 1961). NB: field size, at least in the Ghasel, has decreased since the 1950s (Muscatt, 1993). (a) Liemu Valley, Blue clay basin, fertile; farmed valley slope, with much woody growth above and fruit trees below; narrow steep terracing above left, shallower on right; base is bowl-shaped; the gently winding (partly straightened) Liemu is in the centre at the lowest point; field size varies with slope.



(b) Wied Qlejgha. Coralline-capped hills with wide, moderately sloping valley; the river is walled and sunk; downstream, the valley floor widens to give shallowly-sloping farmland by the river.

it is in the late twentieth century when, even though farming yields are good, there is no (current) way a land the size of Malta can support 360,000 residents, the local livestock and a million tourists annually. It is more

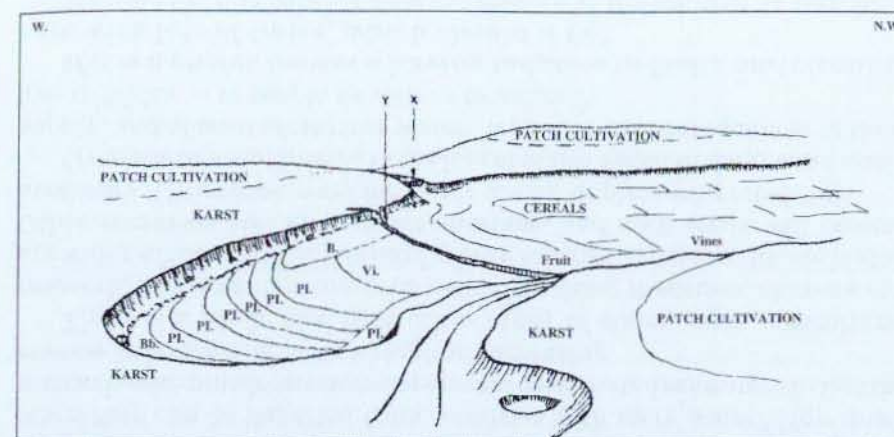
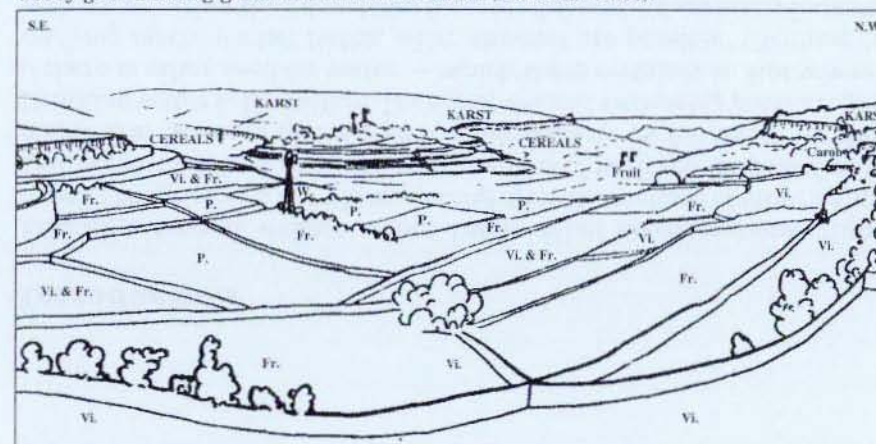


Fig. 4.2 (c) Santi Valley (Y and X indicate cross walls). Coralline uplands with a large embayment; a well watered gnien line below the scarp (water flow channel not marked. See Fig. 13.2); woody growth along gnien line and in the basin (fruit and vines).



(d) Wied ir-Rum. Rather similar to (c).

surprising, in these circumstances, that farming has continued to produce a little of everything (in effect), rather than move to the cultivation of a small number of crops giving the highest yields for least expenditure of scarce resources. Crete, for instance, produces mainly olive and vine. In Malta, the scarcest resource is water, the next, soil (Haslam et al., 1977). (This possibility of crop uniformity makes it the more important that plant genes are preserved, as described above.)

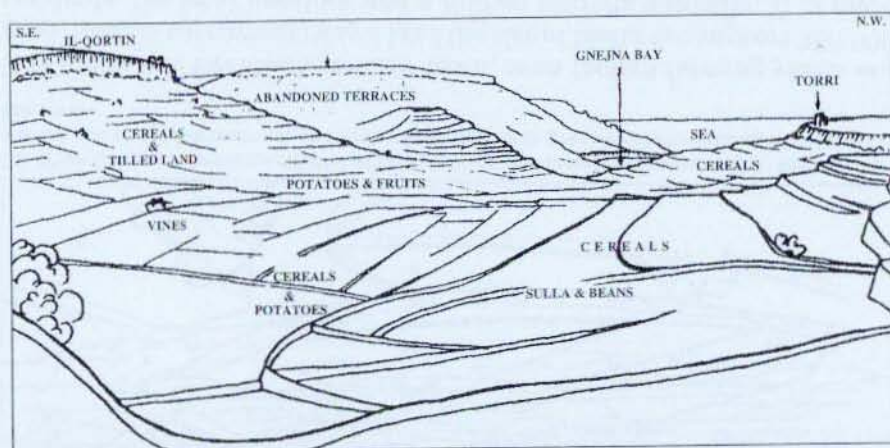


Fig. 4.2 (e)
Gnejna Valley. (Also see 4.1(d)).

The 1988 FAO Report prepared for the Government of Malta, "Towards Agriculture development in Malta: opportunities and options", confirms that Malta is a net importer of food and agricultural products when the value of imports and exports are examined. In 1986, total agricultural exports amounted to US \$ 26.628 million whilst total agricultural imports amounted to US \$ 142.542 million. The preceding years 1984 and 1985 also registered relatively the same levels of net inflows.

The self sufficiency ratio (SSR = local production/total domestic demand) for cereals in 1985 was only 6 % but for vegetables it was 95 %. For the same year, total fruit self-sufficiency ratio was 44 %. However, since 1990, production of out-of-season strawberries, melons, tomatoes, green pepper and aubergines has increased dramatically, due to increased investment in protected cropping techniques such as greenhouses and cloches and also in more use of the drip irrigation system. This lessens soil erosion, since the soil is occupied for several years (not just during the few months of cereals).

Key to Symbols in Figs 4.2

- X. Garigue
- F. Fallow
- Pl. Tilled
- B. Barley
- W. Wheat
- P. Potatoes
- S. Sulla
- Bb. Broad Beans
- Pe. Peas
- C. Chickpeas & Vetches
- Vi. Vines
- Fr. Fruit
- Ve. Vegetables:
- A. Artichokes
- C. Cauliflowers and Cabbages
- K. Kohl Rabi
- M. Marrows etc.
- T. Tomatoes

5

WATER SUPPLY

Introduction

Ethically, human welfare comes before other considerations. Human greed, though, has a low place, coming after the welfare of other animals and vegetation, and after the conservation of heritage. In practice, this distinction becomes blurred and is particularly so for water in Malta. Drinking water is for welfare. Dishwashers and swimming pools are greed if there is other need for water — which there certainly is. But where do washing machines lie? Baths, when showers are possible? Cleaning cars with water rather than dry cloths is surely dubious, as are many industrial practices. And what about farming? How much study and recommendations — and indeed laws — go into the use of low-water-demanding crops, and strains of crops and efficient irrigation systems? Why grow potatoes when they can be imported from countries with more water? How much water should come from (more expensive) desalinated seawater? In fact the reverse is happening, with irrigation increasing.

There is a whole field here of the study of ethics, costs, agricultural research, and economic research (which washing machines, showers etc. are water-efficient). This has hardly been touched, outside or inside Malta. Other countries also have water shortage, and such study will become necessary. Otherwise, wars for water are an unpleasant probability.

Over-use of water has led to the loss of Malta's good underground water supply, and of most of its river water. What are the consequences of their loss to Malta — to people as well as to nature?

If it is a choice between having tadpoles in Malta and cleaning cars with lots of water, which should it be?

Meanwhile, it is only possible to summarise the position as seen from

different viewpoints. From the viewpoint of this book, much more water should be allowed to take its natural pattern, and flow in the wadien.

The Water Services Corporation

The Water Services Corporation Act 1991 is concerned with potable and non-potable waters, their production, distribution, treatment and disposal. The Water Services Corporation has the sole and exclusive authority to acquire, produce, distribute, sell, export or otherwise dispose of water (other than bottled table water) for domestic, commercial, industrial or other purposes. It is also required to conserve, augment and operate water resources, and to satisfy, as economically as possible all (human) reasonable demands for water. There is, most regrettably, no duty or recommendation to conserve natural resources or other equivalent to duty imposed in Britain. There, the Authority has a duty (to such extent as it considers generally desirable) to promote the conservation and enhancement of natural beauty and amenity of inland waters and their associated land, and to conserve the flora and fauna which depend on the aquatic environment. Put more simply, conserving the water environment is, to some extent, required and enforced by law.

The Water Services Corporation shall, as far as it can, take such steps from time to time as may be necessary for ascertaining the wholesomeness of water supplies. Therefore full analysis for all probable poisons are at the Corporation's choice. Analyses are not required by the Act. The Water Services Corporation is, though, not liable for flood damage, and does not control household cisterns or wells (as long as there is no waste or misuse).

Water Resources

About 52 % of tap water supplies comes from Reverse Osmosis plants. This is totally non-damaging and beneficial to the wadien (whatever may be said against on other grounds!)

The rest comes from surface and groundwaters, both Government (Water Services etc) supplies, and farming ones. Government uses boreholes and springs, farmers these, and impoundments, surface collections, and the — according to the Times of Malta — over 1600 registered boreholes as well as the unregistered ones, none of which are metered. The household

wells and cisterns form a small third supply, with swimming pools, another growing demand.

The natural water sources are the gnien springs (those between limestone and underlaying Blue Clay, usually under scarps), springs from the flatter *Globigerina* areas, boreholes etc. to the Upper Water Tables above the Blue Clay, and to the Lower one. The Lower Water Table was a lens-shaped mass of fresh water, replenished by the annual rainfall, lying over sea water below.

What has happened? The Upper Water Tables are too contaminated by agrochemicals to be potable in areas such as Dingli, and contaminated by urban and road runoff in built-up or busy areas. The Lower Water Table has been over-used and the freshwater lens is exhausted and contaminated by sea water. Replenishment by rainfall would be inadequate even with past levels of percolation down to the aquifer. Now, though, some of the most favourable regions for such percolation (e.g. Pembroke, St Andrews and the southern cliffs) are being partly built-over. In addition, the road pattern takes much of the rain direct to the sea, not to the aquifer. Much of this water is now polluted (see Chapter 7) so itself pollutes the aquifer.

Wells were — and are — used for both house and farm. In the past, before refrigeration, perishables like milk, butter and meat were hung in buckets some 60 cm above the water level (to avoid splashing). The buckets were old ones with holes, so if lowered too far the foodstuffs would not float off.

The gnien springs (and wells) supplied the early peoples all year, and were the principal summer supply almost to 1880 (the flow lessened in late August, but increased again before the rains came). Even in the 1920s there was plenty of water, though it was polluted when both the limestone was too thin to be a good filter and the incoming water was polluted. As well as springs, water was pumped up from above the clay layer (Borg, 1927).

The deep level water under the *Globigerina* and Lower Coralline rock went down 0.5 m and more below sea level (Borg, 1927), so when over-used, sea water could flow up easily. Mr. O. Chadwick constructed long galleries a century ago from the Sewda (near Attard) to a pump at the Kbir (near Armier), which was for long the major source of mains water, though boreholes etc are scattered around e.g. Hemsija, Lija, B'kara, Hamrun and Qormi. The flow was even throughout the year. (Borg, 1927).

(Another late nineteenth and early twentieth-century source was the superficial water of the main marshes (Burmarrad, Rihana, Mellieha, Manikata, Ghajn Tuffieha, Mistra, Marsa and Qormi). Rainwater accumu-

lated at sea level, and could be pumped. (Borg, 1927). Further drainage has reduced the supply, and land pollution has increased: even a century ago its quality was usually fit only for farming (stagnant, organic-rich water, then). The supply continued through the summer since much irrigation

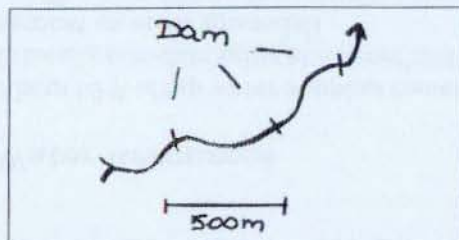


Fig. 5.1
Frequency of some dams. Chadwick lakes, Wied Qlejja, Ghasel

The distribution of dams in Chadwick Lakes is shown in Fig. 5.1. They are sited at nick points in the long profile, where the profile helps the function, and where there are (or were) springs bringing water into the impoundment through, formerly, most of the summer. Cassar (1967) notes stagnant water throughout the summer in the valley near Rabat in the early nineteenth century, and in general terms, stagnant water as frequent.

The standard large dam as pioneered by Mr. O. Chadwick is shown in detail in Fig. 5.2 Other dam types are shown in Fig. 5.3, but the variety in the Islands is much greater than this. Dams are found widely, in very remote and unlikely places as well as in the main widien (e.g. Chapters 12 and 13, and Ap-

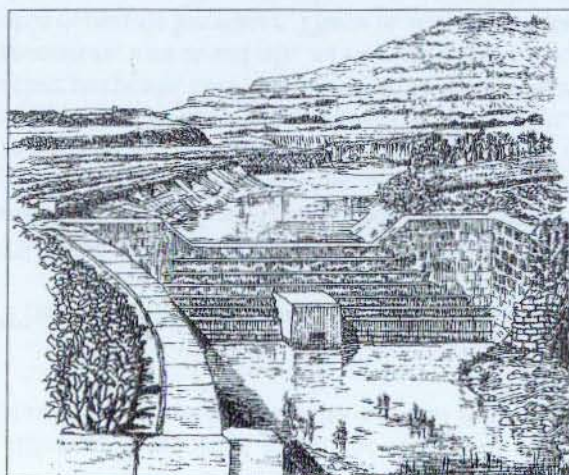


Fig. 5.2
Standard older dam (Haslam, 1990); well made; well buttressed, walled; chamber in front contains end of pipe from upstream side, with stopcock available for draining and overflow; note depths below ground level, bank types and sparsity of vegetation (no buffer strips); *Globigerina* limestone often outcrops downstream of such dams; upstream is dredged, with accumulating silt.

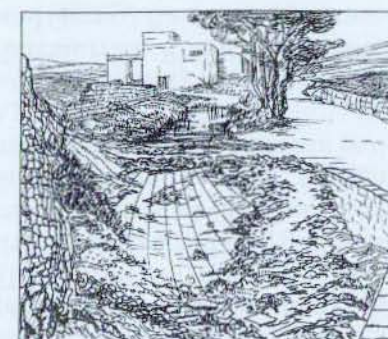
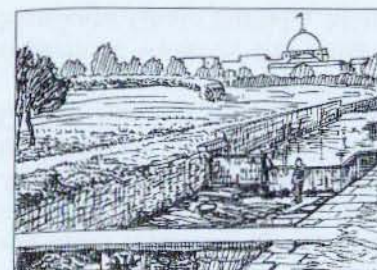


Fig. 5.3
Other dam types, (Haslam 1991), see Fig. 1.3 and Figs in chapters 12 and 13). (a) Top left: Simple, not strong dam. (b) Top right. Good Luck Valleys Scheme (Risq il-Widien) 1980s dam and farm crossing.

pendix 2). Dams can be as close as every 50-100 m over quite long distances (e.g. lower River Sewda, Wied il-Qlejgha, River Ghasel). Outside the three main widien (Ghasel, Kbir and Sewda) there are many more dams that do not, in ordinary winters, fill, and even in these main widien there are some dams that do not, in ordinary winters, fill, and even in these main widien there are some dams whose impoundments are normally dry (see Chapter 2). Presumably, when built, these filled — at least fairly frequently.

The dam-and-impoundment system, as started by Chadwick, is now only for farm use. Water may be piped off slowly, or may be removed all at once, either piped to a local reservoir or taken by water tanker (bowser) anywhere in the Island.

Most unused dams are just that, unused. Fig. 5.3, however, shows one converted for crops. Soil fills the area above the dam, and this makes a very nice field.



Fig. 5.4
Dam with impoundment filled to become a field (Gnejna Valley).

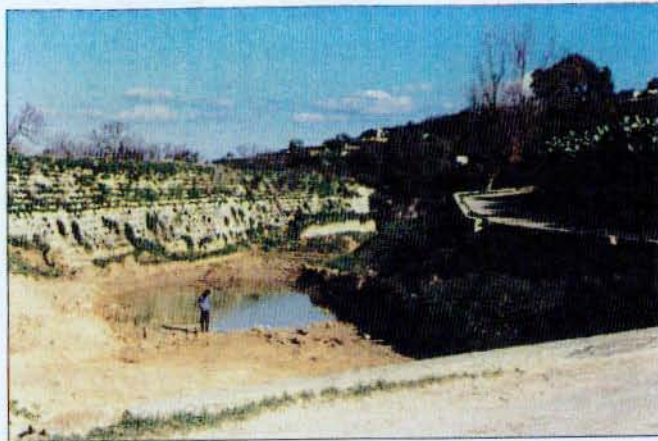


Fig. 5.5
Badly dredged impoundment; no care for conservation; note difference in slope around the dredged area.

Restrictions on Water Use

When water has been available in an increasing supply, and that supply starts to decrease, those using it think either that their little use does not matter, or that if water is going to run out, they are going to get as much as they can, first. Hence restrictions are unwelcome, and enforced to only a small extent. Many houses have rain-water wells and householders do not pay for the water they draw from the wells. Farmers take from boreholes, wells and springs, registered and unregistered, small quantities and large. Bowser contractors draw their water mostly from spring boreholes: which might be more profitable to the farmer than using the water to grow crops!

The legal position is:

1. **from springs and underground waters** (Figs. 5.2, 5.6): no new boreholes etc. are allowed, and extraction rates from existing boreholes (not run-off collections) should be monitored. Only pumps with a lifting capacity of up to 1,000 gallons per hour are allowed as replacements, and when a wind pump is replaced by a diesel or electric pump, capacity must be reduced to one-third. Water Services abstraction is restricted by the quality of the water: by excess salt, nitrate etc.

Private springs are private: only unwanted water is allowed by the owner to flow downstream, the rest is used at source. A few springs are government owned, e.g. the Gheriexem spring at Rabat. Here local farmers share the water, which is free, and government bowsers are forbidden from depriving the farmer of this water.

2. **from wadies** (Fig. 5.5): farmers using fields by watercourses may

abstract freely. Bowser owners also take water from impoundments, without legal right, and they may be stopped by farmers, particularly in a dry year and towards the end of the rainy season. Downstream users have no rights to have water passed down to them. The present position was obviously not foreseen by Ancient Custom, when river water was ample for the demand.

Where law developed in stable conditions, rights were prescribed. In Britain, water must be handed on to the next downstream user in the same quantity and quality as it was received. Except, that is, for the Water Companies abstracting by special and new law, sewage treatment works, industry etc polluting by licence. In the drier American West, where, as in Malta, water is in short supply, "First in Time is First in Right". That is, the first to put up e.g. a dam has the continued right to have the water for that dam: later dams sited upstream may not take water away from the one built first, "the First in Time". The absence of such law in Malta shows the absence of water shortage.

Farmers may also dig sumps to catch more water with a pump, e.g. holes taking at least 50 gallons. To-date, pumps in impoundments are unregulated. Impoundments and ponds should be excavated only by the Water Services Corporation or a Government Department, but in practice farmers and bowser owners also do so. That partly explains the shockingly poor excavations: done with no view to conservation (Fig. 5.5, and see Chapters 10 and 16).

Dams and open storm water tanks (as in Msida, Zebbug, Gudja etc.) are the responsibility of the Water Services Corporation, but are usually constructed by the Works Division of the Works and Reconstruction Ministry. Small dams up to e.g. 2 m high of stone walls, rubble or debris are illegally built by farmers or bowser owners. Unlike the Government ones, no hydrologist has advised on flood hazard: low dams are not necessarily safe dams. Safety depends on siting, discharge etc.

3. **from cisterns and tanks filled with direct run-off or small streams diverted to fill these:** these last are primarily built for flood relief (as in Msida). Then the water, perhaps disgustingly polluted by run-off, sometimes, as at Msida, even including sewage, is removed for irrigation either privately or by the Government.

Water Quality

Potable water is intended to keep to World Health Organisation standards, but in the absence of published results of all analyses (see also Chapter 7)

and given its taste and, often, its appearance, "intended" is probably the operative word. The tap water, even though it is 60 % reverse osmosis water (clean) is always a long way from the standards of bottled water, as is admitted by the Water Services Corporation. Industry and farming choose their own water quality, irrespective of any consequent pollution of soil and food (see Chapter 7). The Government helps livestock units when the piped supply becomes inadequate (usually between April and October). The Luqa (Schinas) reservoir is particularly useful here. The Water Services Corporation is also monitoring and checking mains water supplied to farms more closely than before. Not surprisingly, disputes arise concerning the sharing-out of water, and these can go to Court.

Water Loss

Rivers have turned to dry valleys over the last century and a half (Chapter 2). Widien described in 1853 as little rivers, slow-flowing water, or waters (Grech Delicata 1853), in 1927 as streamlets, and places damp all year (Borg, 1927), even in the 1960s as damp with months of water (Haslam *et al.* 1977), are now dry much of the time. Only a few, like Bahrija, have permanent flow in parts, but this is a trickle, not the wide brook of earlier times (Chapter 12, Fig. 1.3).

Less water is going underground, less water flows as run-off to rivers, most spring water is abstracted at source; more water is abstracted from the water table, and from the rivers, and damp ground in marshes and valley floors has been drained.

Malta has almost killed her rivers.



Fig. 5.6
Waterworks abstraction from river bed (Haslam, 1991).

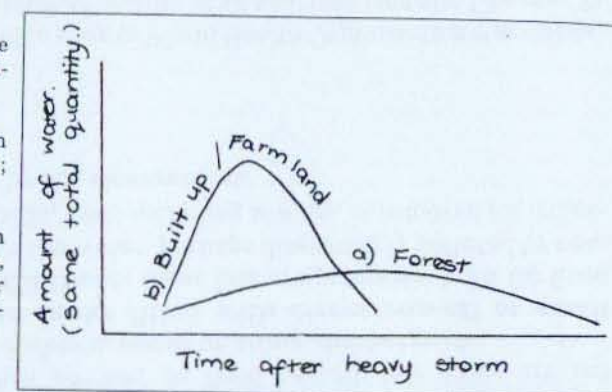
(a) Left: Large borehole. (b) Below. Small one.



Fig. 5.7
Changes in run-off discharge with increased human impact, diagrammatic.

(a) Low peak, long duration flood from forested area; least water force.

(b) High peak, slow duration flood from farmed and, more, built-up areas; most water force (grassland etc, is intermediate).



Change in Run-off (Figs. 5.7 and 5.8)

Run-off has changed over the centuries, increasingly so over recent years. The more rainfall that can sink into the ground (the more the land behaves like a sponge), the less the run-off, the less the flood discharge, and the slower and longer the maximum flood peak. This is most in woodland: which has not covered most of Malta for millennia. Next come (in this order) maquis, crops, bare soil and at this extreme, built-up land, where no water sinks into the ground, all run-off goes straight downhill. Here floods develop rapidly with high and short-lived peaks. With, now, much run-off going through the road system to the sea, less reaches the widien. Flash floods are thus increasing, and therefore the chances of flood damage are also increasing as settlement and roads increase. It is ever more important that storm water channels are kept clear, and that terraces are maintained (or altered) for soil protection from storm erosion.

The system of draining roads into the sewage system in settlements might have worked well when the population levels were much lower and buildings less spread out and none, high-rise. Now this is not so. During a normal downpour manhole covers of the sewage system frequently pop up under the pressure of fast moving run-off rain-water and sewage, to form fountains. This is frequently seen in Lija, Balzan Valley, Msida, Marsa and Qormi. Other reasons for flash floods in built-up areas may be the (suspected) malpractice of constructing rain water wells in houses which are far too small in relation to the roof area, and that such wells are not built at all, breaking building regulations in order to "save" (?) money. Government, unfortunately, at times has not set the best example, as when

building housing estates without providing adequate reservoirs for run-off rain-water — or none at all as at e.g. the Ta' Pennellu Housing Estate at Mellieha, the Zebbug Housing Estate or the Pembroke/St Georges estates. The same could be said for some industrial estates such as the ones at Marsa, Hal-Far and Rinella.

River Farms and Gnien Farms (Figs. 5.9 and 5.10)

It is a relief to turn to farms on old sites, developed for the water available to them. Rivers are seldom the main water sources for major settlements, these usually being on springs, small tributaries or underground supplies. Most Malta farms were clustered for defence and company. Such old farm patterns are characteristic of Europe.

Two types of farm, though, are outside the main settlements and are by water. River farms were built on flowing water and used this for their survival. These are most common on the Kbir, along the lower Girdenti and Luq and downstream of their confluence (on the upper Hesri, the Ta' Brijja region). Here river farms are grouped, but occasional farms are found widely scattered, e.g. on the Gnejna. They occur on flat land beside the rivers, where building was easy and, necessarily, where deep floods were

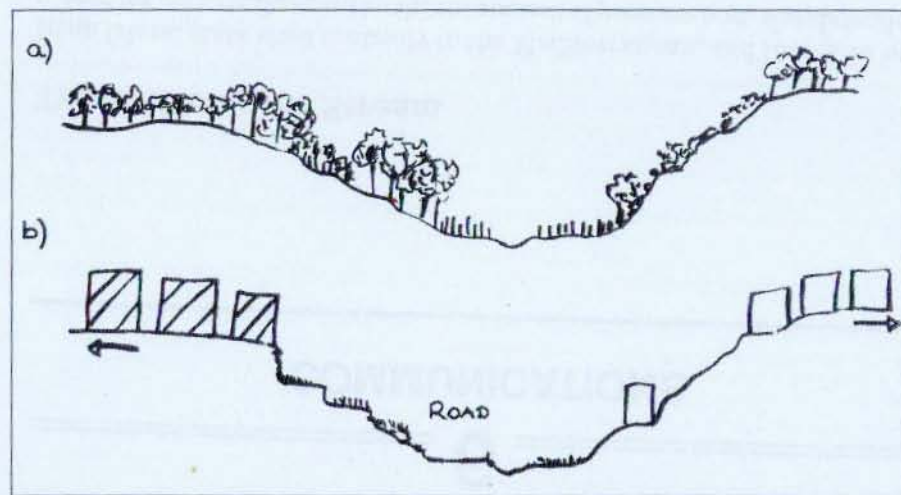


Fig. 5.8 Run-off patterns, ancient and modern, diagrammatic. (a) Rainfall absorbed by vegetation, slow flows. (b) Rainfall with quick run-off, much to roads, not river.

Water Supply

Fig. 5.9 River farm.



Fig. 5.10 Gnien farm, farm above a gnien spring-line area.



infrequent. The river water included much spring water, so flow tended to be stable. These springs flowed, copiously, most or downstream all of the year. These farms are now merely farms by rivers. However, comparing them with other buildings beside rivers, those on sites of more modern date, show that the river farms grew for and with the rivers, while the modern houses just happen to be in that place, and have no such connection with the river.

The gnien farms are scattered on the top of scarps above gnien (spring) lines. Unlike the river farms, the farmhouse is not on, but above the water source, above the diseases (e.g. malarial mosquitoes) of the wet land. Wells provided house-water, and the perennially-running springs of the gnien below irrigated the fields and watered the livestock.

6

COMMUNICATIONS

Travel Along the Stream

In an Island state sited centrally in the Mediterranean, and therefore well placed for being influenced by the movement of peoples (and, if undefended, of raiders), the first priority is military communications, the means of giving the alarm to the garrison, and of getting those garrison troops to the coast.

Farm workers must get to and from farms. Because of the insecurity, until the twentieth century most farmers lived in tight-knit, fortified (or semi-fortified) settlements, and went daily to the fields, rather than living by their fields. Also, in early times the prehistoric temple cultures required access roads from ports to temples, and inns or equivalent. Recently, roads for leisure traffic, both local and foreign, have been developed. There was, also, a military network. This was centred first on Mdina, later on Valletta and later still on the garrison areas. The civil network which included the railway, tram and roads for freight, was earlier less efficient, but now there are no solely military roads (outside military areas).

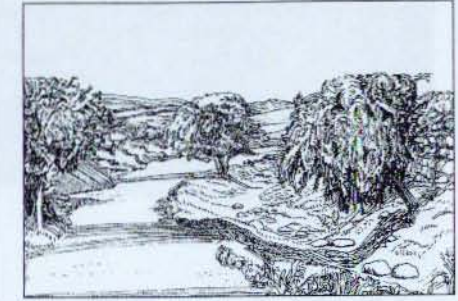
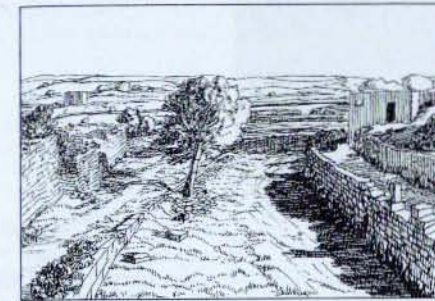
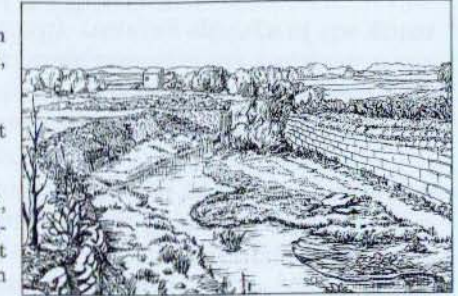
Most wided beds, as public property, were available for civil traffic, and in parts would have been the only lawful routes. Within living memory these beds were the normal Ways for those walking between various villages (and most did walk: horses and carriages were for the few, carts were for produce, and walking was for the many). This would have been a standard use of many widien, the floors becoming hardened and worn over the centuries. At present, of the about 100 km of main widien, nearly half have "Ways" marked beside them on maps (on the bed, on the floor by the main channel or on land beside the bed). This is, however, an under-

Fig. 6.1
Possible stages of development from path in stream valley to road beside stream (Haslam, 1991).

(a) Right. Footpath at side of bed, on highest part but still liable to flood in wet periods.

(b) Below, left. Footpath at left side of bed, raised above main bed level, so with less liability to flood. (On right side, wall has been built into bed (is at the deepest part), to allow an access road to be built.)

(c) Below right. Track at side of bed has been dug out deeper and narrower, allowing the track to be developed with little land taken from outside the watercourse; bank slope shows digging and walling; bed is suffering from lack of maintenance; pipe brings in channelled run-off from field.



(d) Below left. Minor road at side of bed, created by both infilling bed (right side) and excavating outer bank (left side); the 1.5:1 bank slope is typically man-made; stream is obviously narrowed.

(e) Below right. Larger road at side of bed; trees were planted earlier and do not fit with new road; the road is now walled from the narrowed bed; the new wall is intended to resist storm erosion as well as support the road. Contrast all features with (a).



estimate of current Ways, whose length has been much increased by new public roads, new farm roads, new tracks made by visitors, by offroading etc. It is thus difficult to assess the length in, say, 1830.

Footpaths can develop into main roads, (Fig. 6.1 (a)–(e)). People walking create a path. This is widened by more people and their vehicles. Next the way becomes “made”, that is, given foundations and smooth surfaces, and finally, though only recently, tarmac and wider tarmac have been laid. (The increasing height of the Way should be noted too. Cars do not like being flooded!).

Tributaries which are walled and now not much flooded are often used as farm tracks (see Fig. 6.2). The waterway is the pathway (though now there may be a small channel beside the road). These are frequent.

In several places (on e.g. the Ghasel and Sewda) there are incised grooves on smooth *Globigerina* outcrops in the bed (Fig. 6.3). These are presumed to be cart ruts. The cart in Fig. 6.4 is passing along a shallow stream. The water can be at least 75 cm deep before movement by cart is much impeded, and 40 cm, for walking. Constant passage would produce a hard bed and also ensure that little vegetation could grow on the bed. Pictures like this are frequent from both England and the continent: clearly, passage along a river could mean passage on either dry or flooded watercourses. Flooded watercourses can also carry boats if the flow is not torrential and the depth is adequate for rafts and small barges. A water depth of 20 cm may be sufficient for a light load on a boat. Fig. 6.5 shows rafts moving goods downstream. Barges in use in the harbours for loading and unloading from ship to shore would obviously be available for river transport if the water was suitable. These would probably be poled or towed. The paving on the Kbir-Qirda junction appears of better quality than if done solely for local transport, and so could be part of an old main route to Siggiewi (S. Busuttil, personal communication). The 1997 works at Fiddien (River Ghasel) uncovered a stoned Way there, beneath the accumulated sediment.

Travel Across the Stream

All cross-stream routes necessarily cross the stream, whether travel is by foot, hoof, cart or carriage. When there is a route used by many, the route across the stream is formalised, made into a Way that can be maintained (no cliffs, deep soil, swallow holes etc), and that is narrow (as maintenance

Fig. 6.2

Walled tributary, now a farm track. Except after very heavy rainfall, this is now passable for pedestrians and farm vehicles, it is sited at the low point of the valley; walled on both sides; lined on the steepest part where flow and vehicles could do most damage.



Fig. 6.3

Supposed cart ruts on river bed. Found in several parts of the Sewda and Ghasel on river systems on flat *Globigerina* limestone outcrops.



is expensive). The place is chosen partly by the general direction of the route (e.g. a military road would go as straight as the landscape made feasible for fast horses from the coastal look-out post to Mdina), partly by the exact site on the stream on which a good crossing could be both made and maintained. With increased technology the latter becomes irrelevant: crossings, given enough money, can now be made anywhere. Another factor is land ownership. Military roads take precedence over landowners' rights to till the ground instead. When these are built like Roman roads, they then carry the civil population for centuries also. Where military routes do not pass, the roads are civil. Civil roads take precedence over landowners'



Fig. 6.4
English stream used as a road (J. Siberichts, 1627–1703, by courtesy of the National Gallery London. Detail). The water is around 30cm deep; carts keep people dry, being well above water level; pedestrians get wet; stream with hard smooth bed (compared to roads of the time!) and available to the local population.

rights only at periods like the late-twentieth century when the Government can dictate and there are such things as Compulsory Purchase Orders. (With a non-dictatorial Government, crossings are confined to places determined by ancient customs, charitable foundations, or the payment of tolls. In general, European patterns followed all three).

The simplest way over a river is a ford (Fig. 6.6), a smooth hard bed over which many feet and wheels can pass without damaging the bed. The remaining Malta ones are on smooth (well, relatively smooth) *Globigerina* beds. The next step up — still common in many rural parts of England — is to put a foot/horse bridge beside, so these can pass easily, while carts and carriages with their greater width and high wheels pass through the water over the bed, earlier bumping around, (as in Fig. 6.4), now smoothly on tarmac (or firm made gravel).

Fords are for shallow water. Where it is too deep to ford easily, ferries (boats now) are used. In shallow waters, men for carrying persons and luggage



Fig. 6.5
Raft and boat for river transport, Ulm, Germany (part) (1497 Nuremberg Chronicle. By courtesy of the Syndics of the University Library, Cambridge). Note the bales of goods and means of transport; large boats (not shown) also in use.



Fig. 6.6
Ford of smooth *Globigerina* limestone, with columns formerly supporting a packhorse bridge beside (now destroyed), Wied is-Sewda (Haslam, 1991).

were used. No evidence has yet been found for ferries in Malta, but ferry men, at least, would be probable across the major wieden in winter. (In the legend, St Christopher is a ferryman).

Narrow bridges, wide enough to take a horse, mule or person at some speed, strong enough to last for decades or centuries, are the earliest of those now found (Fig. 6.7), and the next step up from simple slabs or planks. In England these are known as pack-horse bridges, being made primarily to take trains of horses carrying freight across country (a predecessor of the lorry). Given the size of Malta, no such pack-trains were necessary, and so even if any of these bridges were not military, they were not pack-horse either! In the absence of any Maltese name, however, the term pack-horse bridge had better continue. They now have ex-fords beside (i.e. tarmac roads with pipes carrying water below them). The Figs. show clearly the varying ages of different bridges and parts of bridges. They are of extreme value, particularly the Liemu ones, and all future repairs should be done by experts in ancient stonework, not by throwing concrete about! The Liemu ones lie on routes from the south coast to the Mdina garrison, the

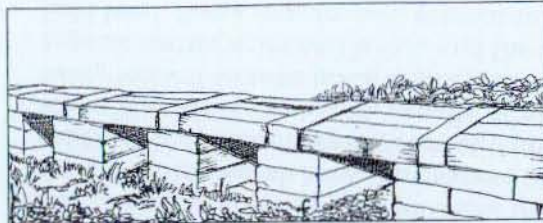


Fig. 6.7
Packhorse bridges (Haslam, 1991a).

(a) Above. Burmarrad. (b) Below. Wied il-Liemu.
(c) Bottom. Liemu. (Stonework of different periods).

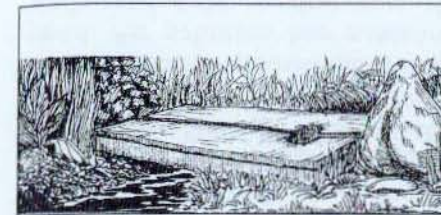


Burmarrad one was for crossing the wet Burmarrad marsh, by causeway.

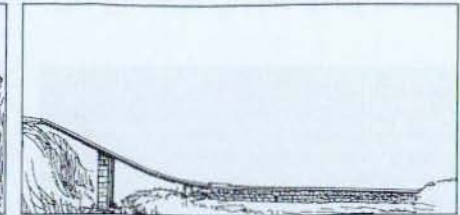
It should be noted, and noted well, that bridges (before the days of higher technology) were needed only over water. Dry valleys had roads like everywhere else. The presence

of an old bridge means the presence of water for enough of the year to make crossing through water a major inconvenience. Various other bridges are shown in Fig. 6.8. from simple farm bridges of various types (some like more modern versions of packhorse bridges) to modern fly-overs. Fig. 6.8 (e) and (f) show the change from the simple cart-bridge at right angles to the narrow road to the same with large turning areas for motor traffic. Chapter 12 describes, in Wied il-Faham, an inter-

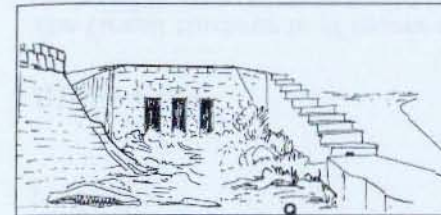
Fig. 6.8
Other bridges (Haslam, 1991a, b).



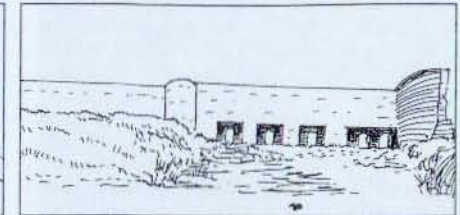
(a) Stone slab.



(b) Farm bridge, sloping.



(c) Very solid



(d) Unusual piers

esting sequence of crossings, first low down along the contour, now high above the valley. Malta has an immense and delightful variety of types of bridges. It is doubtful whether any other country could show so many, in an equivalent area. They should all be photographed, dated and described. This alone would make a most valuable heritage study.

Fig. 6.8 (cont.)

(e) Typical pre-cars minor bridge, with right angle join to the riverside track.





Fig. 6.8 (cont.)

(f) The same type now, with wide turning bends at the angles.



(g) More modern version.

Causeways

There were two large marsh areas in Malta, at Burmarrad and Marsa. Marsa was properly drained in the 1860s and the writer has not found crossings for the earlier marsh here. Burmarrad was drained around the sixteenth century, and some causeways are still present (Fig. 6.9). A causeway is a stone Way across wet land, usually at about land level (the marsh itself being too soft to take much traffic). Drained marsh contracts as the soil organic matter dries and is lost, and the causeways now stand well above field level. Some remain; one, present in the 1950s, has regrettably been

Fig. 6.8 (cont.)

(h) Right. Old short farm bridge.

(i) Below. Modern version.



destroyed. They run both across the marsh and along the old course of the Ghasel (to the estuary). The small population, which in 1901 totalled only 185, together with absence of industrial and commercial activity; have contributed towards the preservation of these causeways. The growing of cummin and cotton in Burmarrad in the sixteenth century indicate the fact that the area was already productive.

River Port

The Grand Harbour is of course a sea-port. The Sewda flows into this, and the base of the Sewda was likewise concerned with the port: just into the river, so just qualifying as a river port. Fig. 6.10 (a) shows the Entrance Bridge to the port part: note the change of architecture beyond. Air pollution has substantially eroded the carving since 1986. The Victoria Bridge itself carried sewage - but sewage can go far more cheaply by a lain pipe than by an

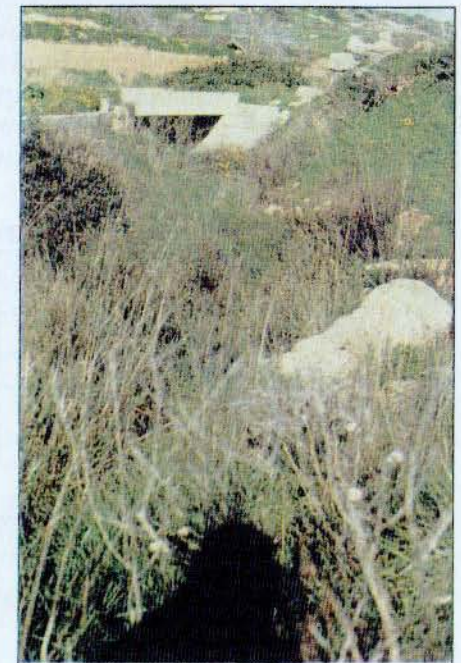




Fig. 6.8 (cont.)

(j) High bridge replacing ground level crossing, old track along contours.

(k) Sturdy bridge allowing flood waters (from land or sea) to pass.



ornamented bridge. Fig. 6.10 (b) shows the origins of this sort of bridge as a fortified entrance to a fortified town. Fig. 6.10(c) shows later development: an Entrance Bridge marking an entrance in the same way an opened

gate or doorway marks an entrance on land. The Marsa marsh had its main drainage in the 1860s (1861, 1869). This allowed the harbour to be enlarged, the Sewda mouth to be more built over, and this port developed. It also improved public health.

River Town

Ships used to come up to Qormi as shown in old pictures. Qormi was in fact at the end of the Marsa estuary, and the start of River Sewda proper, so was

Fig. 6.8 (cont.)

(l) Modern bridge across deep valley for carrying services.



something between a sea port and a river town. A river town is a town built to use a river for access and trade. Fig. 6.11

shows town plans of European towns, and that of Qormi. Qormi, for this purpose, may be divided into:

- (a) St George's, the river town, on a tributary of the Sewda for supply, and with the river for access. This is the part resembling other European river towns. Qormi never developed beyond phase 2, on this hypothesis, but the frequent enemy raids on Romans, Normans, Knights or British in the centuries when there was no efficient defence would more than account for that.
- (b) Central Chapels, also on a Sewda tributary for supply, but with no civic interest in the river.
- (c) San Bastian, modern and irrelevant.

St George's has two probable lines of walls, a smaller, and a later enlargement. The church is up on a hill, the place chosen for forts by the Romans. At that time the Marsa estuary and marsh would have extended near this, and a fort would be desirable in the event of raiders slipping across the marsh. Quite commonly churches were later built on Roman fort sites (e.g. Ipswich, England; Lyons, France) providing a different kind of guardianship.

Jumping many centuries, when the Knights of St John of Jerusalem arrived in 1530, Qormi was of considerable size – for an Island much distressed by poor agriculture and many raiders – with 700 houses and 2,000 people. Despite further raids it rose to over 3,000 in 1667 and 1760. By 1830 there were over 4,000 people and 800 houses; by 1900, over 8,000 people; and in 1961, over 15,000. It is therefore safe to assume the old town was small, but important; in numbers and because it was the fourth of 10



Fig. 6.9
Marsh passage, Bur-
marrad.

(a) Arches in wall to let
wied flood water
through. Compare Figs
13.1 (d).



(b) Causeway for peo-
ple and mules etc be-
fore marsh drainage.
Well above ground level
since drainage.

parishes instituted in 1436 by Bishop de Mello. The Qormi area had many bakeries, and the valleys around were denuded of trees (for fuel). This suggests Qormi supplied outgoing ships.

The men of Qormi and Marsa now have a hereditary right to work as stevedores in Grand Harbour. Why Qormi, not Pawla or Birgu? The easiest answer is that the Qormi men worked at Qormi river port, and when decreasing water or, more probably, increasing size of sea-going ships (which happened earlier) removed the trade from Qormi, the men were allowed to move with the trade.

In Qormi now, there is plenty of riverside space which could have been

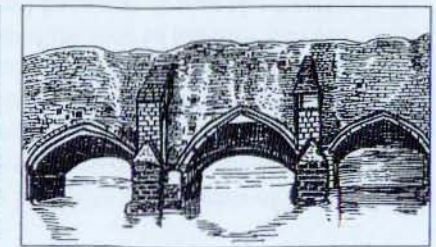
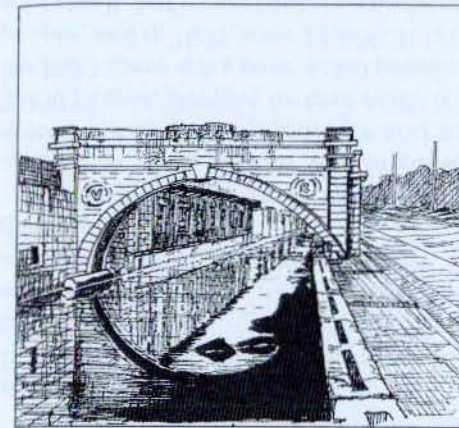


Fig. 6.10

(a) Left. Marsa river port (Haslam, 1991).

(b) Above. Old fortified bridge.
Bury St Edmunds, England.

wharves. There is no direct road uphill to the church, as expected in a river town, but there is the start of one, and streets were later intentionally made crooked in Malta to delay raiders. St George's church is exactly where it should be on this hypothesis, with the market place beside it: the market place would have been of reasonable area when the church was small (before rebuilding to its present vast size), and both were enclosed within the first (and so of course second) wall. Open wharves by the river, secure space in the market place, is exactly what would be expected. A town trading by river must have ample storage space, so goods can wait: outgoing food and materials; incoming foreign goods for buyers from the Island. It needs, too, a controlled area where buying and selling can take place under the rule of law.

Outside the main fortification lines is the Central Chapels area. Typically, a nunnery and monastery were built outside the walls. Here we have St Catherine's (furthest upstream), St Peter's and St Mary's, all on the stream. There is no record whether St Francis de Paule's Chapel, or the older Annunciation Chapel beside it, were originally St Giles. Commonly, churches dedicated to St Giles catered for lepers, in this position (outside the gates, and with water not contaminating other church property).

With all the rebuilding, St George's Church, St Francis' Chapel, and the main road to Qormi from the west, over the Sewda, all face Valletta. This of course must be late, since Valletta is a seventeenth-century town. Malta is unusual in having churches with altars facing in any direction, not to the east, to Jerusalem. Since mosques are required to face east, to Mecca, did the non-east-facing churches start after re-christianisation?

7

WASTE DISPOSAL

Introduction

Two widely held misconceptions are firstly that waste, liquid or solid, put into a river vanishes into thin air — it does not — it stays put or moves down towards the sea or into the rock, and, secondly, that rivers are waste space, unwanted by anyone, no good to anyone. Assuming this, dumping solid waste in valleys is morally neutral or even beneficial (by helping to get rid of the unnecessary waste). Thus river valleys become grossly polluted, mismanaged, and infilled and are often flood hazards (see Chapter 8 for this last).

Changing these sincerely-held (however misguided) views will be a lengthy process of education and law, and when they are sincerely held, they are no cause for blame or accusations of vandalism.

Solid Waste (and Associated Liquids) (Figs. 7.1, 7.2)

This is all too abundant! Rubbish and rubble at bridge after bridge, at roadside after roadside, the rubbish being anything from tins and broken glass to mattresses, fridges and cars, the rubble being building waste. Farmers even dump prunings of vines and trees, brassica stalks etc.

These are:

- (a) ugly;
- (b) cover and smother the flora, fauna and soil;
- (c) may be flood hazards;



Fig. 7.1

(a) Right and (b) Below. Dumping of rubble and rubbish. (Haslam, 1991).

- (d) pollute, changing the chemistry of the soil and of any water above the soil;
- (e) cause harm or death to those animals (mammals, reptiles, birds etc.) which can get cut by or caught up in broken glass, bottles, tins, polybags, wire etc.;
- (f) cause death to children, through (i) leaving fridges with doors left on, so children can climb in, shut the door, and, being unable to open it, die, (ii) poisonous liquids in containers, (iii) unsafe high piles of things;
- (g) harbour pests and diseases.

Rubble is limestone. When wide areas have bare limestone on most of the sides and beds, the rubble does not make much chemical difference. Where, however, the waste is on clay or alluvium, or has deeper soil, the limestone changes the habitat chemically, making it more calcareous.

Rubbish is mixed, and much has a strong chemical effect. Old Jerry cans, bottles, tins and barrels all contained something (not, probably, pure spring water) and therefore are polluting when the remains of the liquids leave the containers. They chemically change the soil and water, changing it so its plants and animals are altered (for instance, the spread of moderate water pollution is associated with the spread of bulrush, *Typha domingensis*.) Hence pollution is that which gives rise to changes, varying according to the nature and intensity of the pollution, in the structure or nature of the plant or animal community. Alternatively, pollution is shown by the effects of substances added or removed by man. This is

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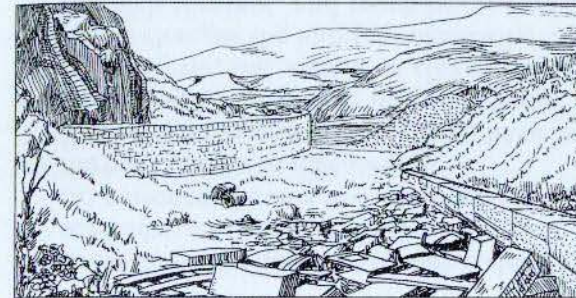


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Fig. 7.2
Polluted Vegetation.

(a) Severe organic pollution, Wied Sewda. Polluted-type blanket weed (filamentous algae). With greater pollution, vegetation is absent.



(b) Quarry pollution, Wied il-Ghasel. *Rumex conglomeratus* growing in turbid water.

pollution, by definition.

What pollutants come from this rubbish? Petrol, battery acid, oil, detergent, bleach, pesticides, herbicides, fertilisers, industrial chemicals — and how many more? Older fridges contain the ozone-damaging CFC (Chlorofluorocarbon) gases. Rain-water washing over the waste collects all chemicals it can pick up — metals, organics and inorganics.

All poison the bed, and, since water percolates down to the aquifer, so do the pollutants it now contains (with some filtering out). Figures are available for petrol. One gallon contaminates 750,000 gallons of drinking water in the aquifer. This is worth much thought. One gallon is not much. Just think of

all the piles of rubbish (and not just in the wieden). Land pollutants too, can leach to the aquifer. How much of the aquifer already contains water unfit for human consumption, dirty enough to pollute the rivers? Aquifers lead to springs. Bottled water may be “pure spring water” in the sense of not being polluted after it leaves the earth, but what is it like when it does leave?

Analysing, whether of river or aquifer water, is for chemicals which are reasonably easy and cheap to test (e.g. nitrates, nitrites, phosphate, chloride and ammonia, sometimes a wider range). There are, however, over 20,000 known organic pollutants (including toluene, benzenes, diquat, and dioxin) as well as the dangerous heavy metals and inorganic pollutants. How many are in the water? How much of each? And from where in the water system do they come? Pollutants exist, whether or not they are tested for: people died of lead poisoning before chemists could test for lead in water. When, only in 1987, a large quantity of an aluminium salt was wrongly dumped in Cornish water supplies (England), the resulting symptoms of anything from rash to paralysis, were long in being associated with the aluminium by the medical profession.

Carcases of animals (from cows to cats) are also dumped in rivers — surely because it is assumed that they there vanish away? Only unfortunately they do not, they decay, with much organic matter polluting the river far downstream, and the aquifer, too. Eventually, natural processes cause complete decay; unless the authorities have found and removed the bodies first. Carcasses and flammable rubbish attract fire which in turn is a hazard to the vegetation.

Quarry dust and small particles can cause severe water pollution, as in the lower Ghasel impoundments where the water is quite turbid with the grey dust. Turbidity cuts off light, so prevents plants growing within the water where light is too low. That is the simple physical action. The particles causing the turbidity have a chemical effect; here mainly, not entirely, that of limestone.

There is a long history of dumping waste in the river — from Attard, Mosta etc directly, and from Mdina by way of a waste disposal channel dug from the fortifications towards the Hemsija. This took the town waste until sewers were laid in the early nineteenth century. The Hemsija tributary, rising near the water gates of Mdina, was perhaps also used. Here, certainly, water was taken for supply, and, inevitably, the local waterworks department became sited later at the same place.

Drying of the wieden meant rubbish was no longer swept downstream quickly and completely. Over-abstraction stopped wied use for removing

waste to the sea. This, though, was accompanied by more sophisticated technology, so the waste most injurious to public health was at the same time disposed of elsewhere (sewerage, rubbish collections for tips). It is mainly the waste objectionable on other grounds that continues to be dumped in valleys.

Over-abstraction preventing waste being washed away by a good flow of water is nothing new, though it has become far more widespread recently. On one occasion this led to a long lasting and — in hindsight surprising — effect, namely, the Judeao-Christian view of hell as a place of fiery torment. The river Kedron runs beside Jerusalem, and a tributary, the Gehenna, used to supply the city. Over-use of the main and tributary streams for consumption, for craft, and for public works like the Gardens of Solomon dried this up as surely, and perhaps even more, than the streams of Malta. The city folk always had put their waste in the valley, to be carried away by the water. When the water could no longer remove it, something had to be done for public health: and higher technology was not available. Therefore the waste still dumped in the (now dry) valley was burnt. The fires of Gehenna thus burnt, and no doubt the valley was smelly and known to be unwholesome also. It became notorious as the most unpleasant place around, as a visit to the Maghtab tip will confirm today.

Effluents (and Liquid Dumping) (Fig. 7.3)

Farm effluent is perhaps the most widely polluting effluent in the Islands, particularly that from pig and cow units (poultry droppings can be sold as manure). The Sewda impoundments downstream of the Attard road bridge are the worst, making the (lower) Sewda the most polluted of Maltese rivers. Different impoundments have different degrees of pollution, as can be seen from the smell and look of the water, the amount of algae (most in severe pollution, less or absent in both gross and mild pollution), and the amount of other vegetation within the water. Fig. 7.3 shows the contrast between a very turbid pollution with a low poisonous element, and a severe organic chemical pollution which is also turbid.

Factory effluents are less frequent, but occur, as in Tar valley, Gozo (Fig. 7.3) where tar used to cover the valley floor. Tar is a disinfectant; therefore it kills. Tar smothers and kills on the valley floor.

House effluents no longer should go to rivers. In older towns (e.g.

Fig. 7.3.
Effluents.

(a) Tar valley, Gozo
(now stopped).



(b) Washing front yard
with detergent (poison), water leaving
house un-cleaned, to go
to wied.



Qormi) house pipes still exist, coming in well above water level (so effluents can pour outwards, but river water cannot come back up the pipe). In a picture of Mdina by Gianni a century ago, a waste channel comes down from the city towards the Hemsija pond below (the picture dates from after sewerage). The persistent Maltese view that rivers are for waste, and that the waste will disappear, implies much waste was put in earlier; and that therefore much water was there to convey it away.

Little sewage got into Malta rivers compared with those on the continent, however. Sewerage came late to many houses, so the waste went into cesspits, which in turn when filled to capacity were emptied on fields



Fig. 7.4.
Road run-off,
disgusting, near block
and turbid.



Fig. 7.5
Urban stream put
underground, St
George's.

etc, or dumped also
in places other
than rivers. Many
settlements just
have no conven-
ient river for
waste, e.g. Naxxar.

Some sewage is now returning to rivers, from remote dwellings and new estates (e.g. Mtarfa) where the sewage is unsatisfactory. Sludge from livestock units may be dumped in river beds (e.g. middle River Sewda) and remain for months, polluting water both going downstream and soaking in to the aquifer.

Road and Urban Run-off Pollution (Fig. 7.4)

This is an increasing, and as yet hardly recognised problem in Malta. With few motor vehicles, polluted run-off is negligible and can be ignored. As late

as 30 years ago, traffic was dense only in the main urban areas (and northern coast road), and from these, run-off ran to the sea rather than to rivers. Now pollution on many inland roads is sufficient to send revolting run-off to many widdien. Because this type of pollution is relatively new, it is often difficult to comprehend – surely that stuff on the Regional Road is good clean soil? But where, there, could good clean soil come from? There is no access. No, this is dirt: tar, petrol derivatives, oil and oil derivatives, tyre derivatives, other hydrocarbons and heavy metals among others. It is truly poisonous. Major roads should have sediment traps at each exit point for run-off, ones that are regularly cleaned out. Run-off should also be cleaned in open, vegetated channels. If not reasonably clean (either at source, or by cleaning), it should instead go to sewage treatment works, and by underground channels. Spills (e.g. from lorries) should never be allowed to reach run-off channels, but should be removed by absorbent mats or granules (see Chapter 14).

Streams are now wrongly put underground, e.g. Fig. 7.5. This should be restricted to channels with water too foul for human health to remain open, and which go to sewage treatment works.

Minor road works can make river water highly turbid for 5 km or so downstream of the roadworks, stressing the regrettable effect of disturbance.

Field Run-Off Pollution

This comprises:

- (a) top soil, the most valuable soil of the fields, but which is a pollutant once it leaves the fields;
- (b) fertilisers;
- (c) pesticides and herbicides (see below for more details);
- (d) manure. Fig. 7.6 shows well what this (perhaps plus some effluent) does to river water: turns clean, clear water into turbid polluted water. Over-use of herbicides (so over-movement to the widdien) is common by trappers clearing land for trapping etc. In addition, the number of anecdotes is too many about farmers who will not let family or friends eat their own produce because of its high pesticide content. (It is not just Maltese food which may be contaminated. Since Malta has no stringent testing of fruit and vegetables as yet, it can be used as a dump for produce unsaleable elsewhere.)



Fig. 7.6

(a) Clean spring water.



(b) Polluted river water nearby. Wied Girgenti. *Myriophyllum verticillatum* present in both, but with different habits; pollution-tolerant *Typha domingensis* in (b).

Field Pollution by Irrigation Waters

When impoundment water is put on the fields, everything in that impoundment is also put on the field, run-off from roads, from fields, from settlements, effluent from farms (now containing all the poisonous substances, fed or administered to the animals or used in the sheds: steroids, antibiotics, hormones etc), from industry, from quarries, pollutants from dumping, etc. Run-off and other liquids have no difficulty in running downhill, into impoundments. Storm run-off brings sediments and all the contaminants

back into impoundments, from which they are again lifted to fields, and so on. Each year, therefore, more new agrochemicals are put on fields, and, as well, more old ones, plus old and new effluent and run-off pollutants come up with the irrigation waters. In the south, partly-treated sewage effluent is used for irrigation, and the look, taste and short shelf-life of the vegetables are often far too easily recognisable.

These have not yet been fully studied in Malta, but the principle of increasing contamination of food crops is causing concern in several Mediterranean countries.

(Detailed chemistry is considered more below: mobile compounds move down in water, non-mobile, with soil particles. Uptake into plants of some pollutants is easy, some difficult. Even when uptake is difficult, once crops are bathed in a high concentration of the pollutant, that small proportion taken up can mean quite a high level of poison in the plants.)

Pollution-Tolerant Aquatic Vegetation

Even supposedly clean spring streams, as in the Gnejna and Bahrija widien, show that they are in fact polluted, since they bear Blanket weed (prominent long filamentous algae) and do not have satisfactory upstream aquatic flora. Low and moderate levels of pollution lead to species-poor communities, skewed to bear too high a proportion of pollution-tolerant species. In severe pollution, only these species can occur, then as the pollution increases, fewer occur and then none, even of the pollution tolerants.

Pollution-sensitive species include:

Callitriche truncata

Chara spp.

Mentha pulegium

Ranunculus trichophyllus

Ranunculus muricatus

Species semi-tolerant to pollution include:

Alisma plantago-aquatica

Nasturtium officinale

Zannichellia palustris

Alisma plantago-aquatica becomes larger and floppier with pollution (until it dies from excess contamination).

Typha domingensis, bulrush, is spreading in mild pollution, as men-

tioned above. In moderate pollution, species include:

<i>Rumex conglomeratus</i>	Blanket weed
<i>Typha domingensis</i>	Phytoplankton (some)
	Sewage fungus

In gross pollution, no vegetation can grow (Haslam 1991).

Conclusions

The pollution entering Maltese rivers is not too serious compared with other countries, whose treated (or even untreated) sewage enters in quantity. However, the status is worse than this implies:

1. flow is inadequate, so pollution is hardly diluted and downstream movement is often poor. These features increase the concentration of pollutants in the water. Cleaning is poor also;
2. there is direct and rapid access to the aquifer from many river beds, so river pollution also contaminates the aquifer;
3. marsh and aquatic habitat is so sparse in Malta, that any habitat loss by pollution is serious — and as much loss as there is now is serious indeed.

Surface waters are now barely clean (except for rock pools with no connection with streams). Most are moderately to severely polluted, some are grossly so. Polluted surface water means polluted aquifers and polluted crops. The current rate of deterioration is very serious.

Over the past decade, vegetation has deteriorated significantly, from pollution as well as from drying and disturbance. The River Rihana has much increased *Typha domingensis* and the pollution-favoured Blanket weed has effectively replaced the cleaner-water *Ranunculus trichophyllus*. In Chadwick Lakes (River Ghasel), pollution has become severe since 1994. In 1996, Blanket weed overwhelmed the bed, its dead remains staying for months after the winter. The tolerant *Rumex conglomeratus* is spreading. Some *Alisma plantago-aquatica* is in poor condition. And along the main river bed the diversity in 1997 was much less and the community, skewed. The pollution was stopped in 1997/8, but it could be several years before the community recovered. With more pollution, it could be decades, or, if water supply continues low, never. Similar case histories come from other smaller sites.

All is not gloom, however. Pollutants can, to a considerable extent be cleaned. Light, oxygen and microbes are the main active agents, aided by plants (and for some plant and animal breakdowns, by invertebrates). Light oxidises, and oxidation renders many substances harmless. Self-purification increases with high oxygen in the water. Oxygen comes in with turbulence and cascades, with shallow water rippling over gravel, and with a certain amount of vegetation. Microbes are extremely effective at cleaning (see below) and are increased by the presence of higher plants.

It is therefore crucial to manage rivers and other flowing waters so as to increase these three features. Water must, as far as possible, be cleaned before entering the wieden, and be cleaned further, once in. However, pollutants should, where possible, be stopped at source and not need cleaning.

Wetland and Soil Cleaning, Buffer Strips

The chemistry details given here are correct for further north in Europe. No one has yet published results on the effects of a Mediterranean summer. (Will a Research Student please go to Cranfield University and do it?)

Buffer strips (Fig. 7.7) are unpolluted or little-poisoned land beside rivers and wieden. They may be 0.5 m wide or 50 m wide, and covered by grass, tree, footpath, garigue or other non-crop vegetation. It is, though, the soil which is far the most important. A rocky outcrop with little soil does very little cleaning indeed. Buffer strips protect the valley floor from part or all of the pollution coming through or over the soil. This pollution may be agrochemicals (fertilisers, herbicides, pesticides), road and town run-off (though no buffer strip in Malta is sufficient to clean the worst of this!), or small effluents of any description.

Buffer strips are not cleaners sweeping up all pollution, but helpers, and sufficiently useful helpers that they should be taken into account in all land-use planning. When some fields of a valley are abandoned, matters should be arranged so it is the fields next to the watercourse which are unused. When there is an equal choice of crops requiring less and more agrochemicals, fields next to the watercourse should bear those requiring less. If more land is brought into production, this should not include riverside land. This is as much for human health as for natural heritage. Dirty water in the wieden means dirty water in the aquifer and so in the tap (see above).

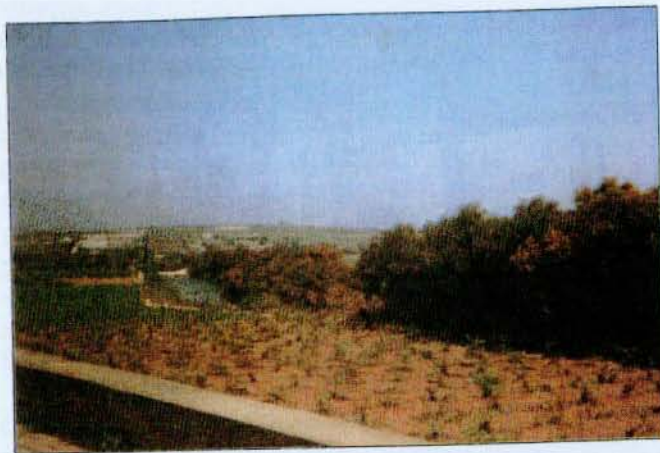


Fig. 7.7 Buffer strips.

(a) Good strip with trees on right; on left, inadequate both in soil and width.



(b) Strip with inadequate soil.

Where calculations have been done, to clean water in a sewage treatment works to the same degree as it is cleaned passing through a buffer strip 10–15 m wide, the sewage treatment works would cost four times as much as taking the land out of production, and maintaining it as a buffer strip. Water Services and road planners please note!

The same cleaning processes take place in the river and valley floor. They should not, though, be relied on in the same way, since:

1. once settled on the bed, dirty water generally goes more quickly down to the aquifer, and
2. the pollution is damaging the aquatic and marsh habitats which are already too rare.

Open streams clean many times faster than those in concrete channels underground, since the open ones have ample light, oxygen (unless very stagnant) and microbes.

Sediment is picked up by run-off. If this flows through soil, almost all is filtered out. If the run-off is overland and slowed by a wide flood area, part or much of the sediment is deposited. That which flows overland fast to the river pollutes the river with the sediment. (It clogs impoundments, smothers and kills plants and animals, alters chemistry and so biota, etc). More attention to practices decreasing storm run-off would also decrease such pollution.

Otherwise, micro-organisms are responsible for most of the cleaning processes (technically, cleaning is mediated by the microbes). No substance turns to nothing, no pollutant disappears, but pollutants dealt with in buffer strips and watercourses may, like nitrogen and methane, escape into the air (so, for this purpose, disappear), they may be turned into harmless and re-usable substances (so are no trouble), but also the pollutants may be stored, whether for short or long periods, and then, though safe while stored, they may do active harm again when out of storage.

Most is known about nitrates, the fertiliser most used on the land. When it enters the buffer strips it can be caught and turned into plant material: new vegetation can grow. Harvesting the plants then removes the nitrate. Otherwise, dead plants decay, returning the nitrate to the soil. Denitrifying processes then turn this to nitrogen gas, which goes up into the air. The wider the buffer strip, the more nitrate can be caught from the water. Underground run-off does not go straight to the valley bed, its flow path twists and turns with characters of the soil and water table, and this flow path may be 150 m long in a 10 m buffer strip, so having 15 times more cleaning than if it flowed straight through. Therefore wide strips are needed more for catching nitrate than for turning it into gas. Both these processes are needed for cleaning power.

A strip 20 m wide — possible in Malta — cleans most or all (70–100 %) of agrochemical nitrate in heavier soils. Wider ones clean more, but are less practicable here.

Nitrate processing is fastest in winter when there are both waterlogged and non-waterlogged soils. (Those objecting to waterlogged soils, please note! Clean drinking water benefits us all.) Waterlogged soils may be in riverside fields or in rivers. Aerobic soils may be in riverside fields as they dry, or in waterlogged wadies with marsh vegetation, since oxygen is

exuded from the roots of those marsh plants. Oxygen comes down the plants from the air above, and forms pockets of high oxygen around roots. Roots are extremely important. They influence the soil around them by bringing in oxygen and by exuding a lot of chemicals (sugars, phenols, amino acids, steroids, growth factors, enzymes, and many more). These chemicals differ between one plant species and another, between one habitat and another, and even between old and young plants. So the more diverse the vegetation, the more diverse and effective the chemical factory brought by the roots.

The chemical factory? In these rhizospheres, soil microbes may be ten or more times denser than in the soil around, and it is microbes that break down (feed on) incoming pollutants. Breakdown of nitrates is best with tall, diverse vegetation, variation in oxygen, and satisfactory organic matter.

Most soil organic matter is humus, though a little peaty material may develop in marshy places. This (humic and fulvic acids) is active in breakdown. It interacts with other soil chemicals, including pollutant fertiliser, heavy metals and organics. The breakdown capacity of humus varies, even between one buffer strip and another, so making predictions difficult.

A lot of phosphate can be caught up in the buffer strip from the run-off coming through. It can be taken up into various soil materials. Unlike nitrogen, phosphorus cannot escape as gas, it can only be lost through flowing out again, or by harvesting vegetation (which of course contains it). So buffer strips can become saturated with phosphate, take up no more, and just let the surplus reach the river. It is hoped that buffer strips can soon be designed to prevent that happening.

Metals also do not turn to gas. They too leave buffer strips only in run-off. Soils, particularly wetland ones, are, though, able to neutralise a large amount of metals (but, as with phosphate, once the soil is saturated with metals, it can take up no more). Also, a change in habitat may release poisonous metals. For the amount of metals in agrochemicals here, buffer strips are entirely suitable. Road run-off, with its high levels of metals, needs watching: newer replacement strips may eventually be needed.

There are over 20,000 known organic pollutants. They come in as biocides, as road run-off, factory and lorry spills and so on. (Not all 20,000!) Few have been researched. Some are taken up by roots of plants, including biocides (agrochemicals), phenols and PCBs (pervasive industrial chemicals), sulphonamides (medicines given to livestock and leaving in farm effluent) and DDT (a long-banned, but still present insecticide, with DDE

as a breakdown product, thought to be implicated in the decreased sperm count of human males).

The least mobile molecules can hardly enter roots. A lot of the compounds that are taken up, like heavy metals, hardly get past the roots, or do so only in small quantities (there are, though, root crops, e.g. carrots, and those receive these pollutants). Some, however, get through into the leaves, fruit and stems. Therefore agricultural sprays should be used sparingly and waste pesticide should never be dumped.

Of the biocides, only those easily dissolved (like aldicarb and acephate) can move fast from field to buffer strip. Others reach the strip or valley floor mostly in eroded soil (of which there is all too much). Fertilisers, mobile metals and mobile organics are the ones most cleaned in buffer strips. Where eroded soil is filtered out, so are the pollutants bound to them.

Enhanced degradation (unfortunately the only name for it!) is something new. Bacteria have evolved to breakdown biocides much more quickly (particularly organophosphates and carbamates). This is good for cleaning, though less so for the farmer: it does not occur only in buffer strips! This enhanced degradation happens more in dry than in wet soils.

Different substances differ enormously in breakdown times (for instance, in half-life times, ethanol ("alcohol") takes 2.5 – 24 hours in the same test conditions in which DDT takes 2 – 6 years). This variation depends on the chemical nature of the substance. Different habitats have different breakdown times for the same substance. Some organics breakdown faster in water than in soil (e.g. DDT), others faster in soil than in water (e.g. malathion). Here the rate depends on the microbes of the habitat. There is a lot in breakdown that is not yet known or understood.

Breakdown is, though, generally much slower in groundwater than in surface water, as there is a lack of light, oxygen and microbes in groundwater, consequently it is of crucial importance to clean the surface water before it reaches the aquifer and becomes groundwater.

Breakdown rate also varies with plant species, some being better at removing one pollutant, others, another. In marshy places, *Iris pseudacorus* is particularly good at removing toluene, *Typha latifolia*, phenol and *Phragmites australis*, faecal bacteria. All can breakdown each of the pollutants, but the efficiency varies, so a mixture of species, a diversity of vegetation, is desirable. (For readers in Malta, see the copy of Haslam (1994) in Malta University Library.)

The Law

Contamination of the water table is the collective responsibility of the Water Services Corporation, the Health Department, the Sewage Department of the Environment, the Police and (if from farming) the Agriculture Department. (It is hardly surprising control is so lax, when responsibility is so divided.)

Water analysis is done at the water table level by the Water Services Corporation. Since no analyses are published or available for consultation, the inevitable conclusion is that either analyses are inadequate or the pollution level of some areas is greater than allowed by World Health Organisation standards.

Monthly analyses for a proper variety of contaminants should be available for not only water tables throughout the Islands, but surface waters and suspected and known sources of pollution such as livestock units, tips, sewage outfalls and seepages, sewage treatment plants, areas carrying sea-water swimming pools (salt contamination, see Chapter 5) and reclaimed quarries.

It is the legal duty of the Water Services Corporation under its enabling Act to provide for the treatment and disposal of trade (industrial) effluent, to effectively deal with contents of sewers, and to promote the proper disposal of waste water and storm water run-off.

8

DANGERS OLD AND NEW

River valleys both protect from, and are liable to dangers.

Drowning

People can drown in water. In England, until better roads came in the eighteenth century, drowning was a normal winter hazard when travelling by road and a year-round one when travelling by water. To a lesser extent travellers and farmers presumably drowned in Malta too: crossing deep water in winter, falling into water, crossing or walking on unsafe constructions, etc. With the present shortage of water and excellent bridges, drowning is not now routine, though it does still occur e.g. in floods due to severe storms (like that on the River Sewda in 1979 and at the B'Kara Valley in January 1998). Near tragedies in floods are frequent. The damage done in September 1997 and in January 1998 is vividly remembered at the time of writing.

Sickness

Sickness was often associated with water and dampness. Except for the river farms (Chapter 5) few people lived close enough to the river to get the river ills, but winter water probably did flood those buildings. Is it possible that river farmers (like the English water millers) had a reputation for being pale and cross? (The English windmillers, on the other hand, lived on hill tops and were considered redfaced and cheerful.) More people lived round the marshes and lakes of Marsa, Burmarrad, Pwales and smaller estuarine areas, and presumably some obtained their living from fishing and fowling these. Marshes also supplied reeds and sedges for roofing thatch, fences, fuel, farm litter etc. The increased population near Marsa after the 1860s drainage was ascribed to better health. Many sicknesses,

from rheumatism to fevers, are associated with dampness. Non-gastric fevers tended to be called (in English) agues, of which the worst was later known as Malaria, carried by the *Anopheles* mosquito.

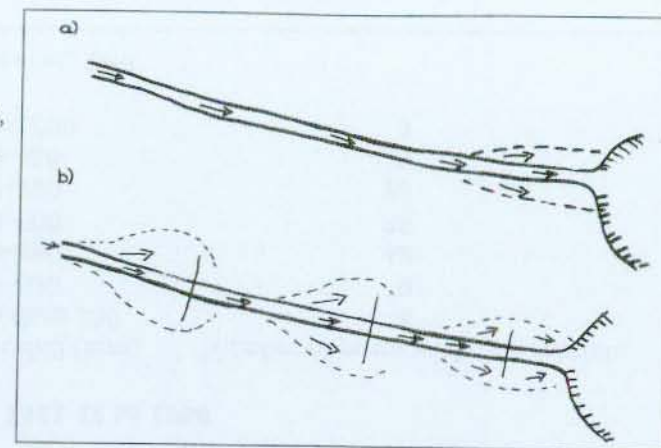
In Malta, the malaria record dates from the sixteenth century, when the Knights of St John reported that "summer fever", "malaria" (probably true Malaria) came from soaking hemp in marshes (and, later, in public fountains). Of course it was contact with the water which was responsible, not the hemp! Mosquito larvae live in the water, and so adults start near it also. A seventeenth century law prescribed the covering of wells and reservoirs in the Qormi region (so preventing mosquitoes laying their eggs there). The stagnant summer water of the Upper Sewda behind Mdina was repeatedly blamed for "malaria" outbreaks in the eighteenth and nineteenth centuries, with repeated prohibitions on growing vegetables after June, and recommendations for drainage. There is no stagnant water there now, in summer! "Swamp fever" epidemics afflicted marsh areas, e.g. Marsa (to the 1860s, the eighteenth century drainage being inadequate); Paola, abandoned in 1801, Zejtun and Zabbar, afflicted in 1802 (thought to be due to collections of stagnant water), Pwales, 1821, when the earlier drainage system had broken down. Eventually, in the nineteenth century, all stagnant waters were ordered to be removed, at the landowner's own expense. Hence much loss of aquatic habitat occurred. Proper diagnosis started in 1897, by which time true Malaria was present, but rare. The few cases after 1904 were considered to be imported. (The last was in Salina, in 1941), (Cassar, 1964).

In the 1940s the *Anopheles* mosquito occurred only in the small wetland area at Salini, and was not infected with malaria. Since, in World War II, there were Allied forces in Malta who had been anywhere in the world, some could have been carrying malaria. Therefore Salini was Out of Bounds for all troops (E.J. Costanzi, personal communication). This meant there was no possibility of an *Anopheles* mosquito biting a soldier carrying Malaria, the mosquito becoming infected, and passing on Malaria to Maltese civilians.

Now, with dry heated houses and insecticides, living by water is as healthy as anywhere else, and many people find it more pleasant.

The cholera bacterium is carried by water. There is no certain evidence for cholera occurrences in Malta before the nineteenth century. There were six epidemics between 1827 and 1911, the first being the worst, with nearly 9,000 cases and over 4,000 deaths. Typhoid fever is also water-borne and bacterial. It was first properly diagnosed here in 1859 (Cassar, 1964).

Fig. 8.1.
Flood damage,
diagrammatic. Note
water force and
upstream floods in (b),
obstructions have
increased the head of
water.



Milder gastric fevers (often violent and fatal) were characteristic of Malta until quite recently, though becoming less violent over the decades. (The introduction of Reverse Osmosis, bacteria-free water no doubt helped.)

Causeways

Solid causeways were built to cross marshes, to give easy crossings and access to harvesting areas (Fig. 8.1 and see Chapter 6). With drainage and consequent drying and shrinkage of soil, these causeways now stand well above groundlevel.

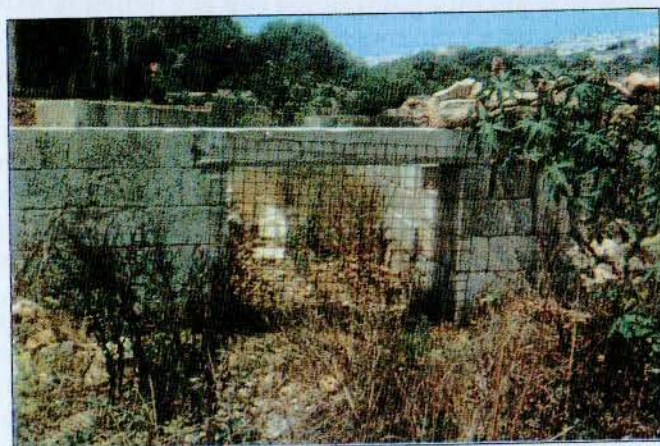
Floods

Flood damage can be considerable. Spring flow in streams is and was normally stable and not damaging. It is heavy rain storms that damage. Some of this is inevitable. Even with the best erosion control on a hillside, a storm of 20 cm rainwater will take off soil. Damage is made worse when the erosion control is not of the best, when free flow of water has been obstructed, and when unprotected buildings have been built where — until recently — local memory would have said floods would come. In the recent population, mobility and contempt for the past have meant ignorance of this unfortunate fact (Figs. 8.2–8.5).



Fig. 8.2
Obstructions liable to
cause flood hazards.

(a) Farmhouse wall
across bed.



(b) Metal mesh across
bed (dangerous as soon
as debris, unable to pass
through, has caught on
the net).

Storm damage for a given rainfall may also be worse if the soil is already saturated with water (so can absorb no more) and the drainage channels are already full with earlier rain-water (Bowen-Jones *et al.*, 1961). Between the climatic years (i.e. September to August) 1841-42 and 1956-67, six years had over 750 mm of rain, with 1858-59 having 980 mm and 1951-82, 850 mm. 1995-96 also had 980 mm. There is much regional variation, e.g. between 1910 and 1940, rain of at least 25 mm in a day occurred on 212 days in a total of seven rainfall stations in Malta, but only 41 days had their amount recorded at all 7 stations. The Naxxar-Mdina area on average is the wettest (Bowen-Jones *et al.*, 1961).

Fig. 8.2 (cont.)

(c) Rubble crossing.



A continuous fall of at least 50 mm is likely to give significant run-off and physical damage, and this is likely to happen on any day with at least 75 mm of rain. (This threshold value for damage may be less in strong winds.) That rainfall happened on 7 days between 1901-02 and 1935-36, and so can be expected once in five years (Bowen-Jones *et al.* 1961, Chetcuti *et al.* 1992). Serious damage occurs less often, so, in modern conditions, people forget it will recur, **but it will**. A once-in-50 years storm recurs on average once in 50 years, and that remains true. There is no evidence of change in Maltese rainfall since records began in 1841-42. There is evidence of much variability, but of no overall change.

Table 8.1

Annual Rainfall 1841-42 to 1956

Total rainfall (mm)	Number of years with this rainfall.
less than 250	4
250-350	9
380-480	42
500-600	35
630-730	20
750-850	3
880-1000	3

Source: Bowen-Jones *et al.*, 1961

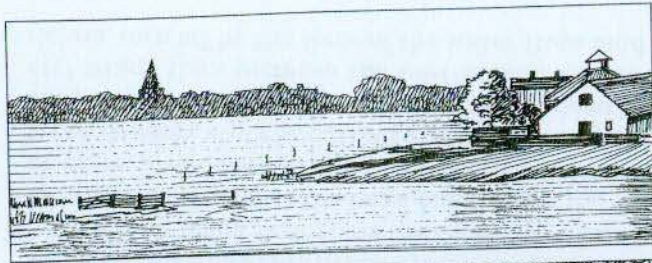
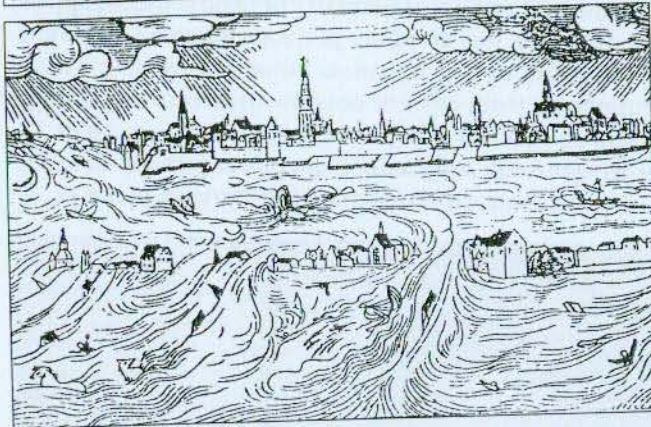


Fig. 8.3
Floods. (Haslam, 1991).

(a) Controlled, water sitting below settlement level, late twentieth century, England.



(b) Catastrophic, sixteenth century woodcut, the Low Countries.

River Ghasel than in Ghaxaq, and by river Ghasel than in Ta' Qali 1965–66 (Government Meteorological data). Daily records can vary too e.g. from 450 mm (Gozo) to 860 mm (Ta' Kandja) (Bowen–Jones *et al.*, 1961; Chetcuti *et al.*, 1992). Apart from the severe 1979 storms, recent years of damage include 1997–78, 1994–95 (centred on north Malta), 1993–94 (centred on Gozo), 1988 (Marsa, Qormi) and 1983 (Msida, B'Kara, Marsa): that is, one year in four in the past twenty years.

The time from the storm to when the river water starts to rise, and then that to peak flow and the end of storm flow, seems under-researched. For one 2.9 mm storm on the Sewda, peak flow was 12 hours after. Run-off has got very much greater recently, so floods peak faster and the peak amount of flow is very much greater. In woodland, much rain is absorbed into the soil so it comes out slowly. In maquis, less is absorbed, in cropland, less again, bare soil has even less, and there is least of all from built-up land (including roads). Given equal rain etc, flood flows are greater and arrive quicker than before, so are potentially more dangerous.

Annual rainfall within Malta can vary greatly, e.g. four times less by

Fig. 8.4
Unsafe building, Birzebbugia. (Haslam, 1991). Protected above by dam, and by new runway, but of dubious wisdom.

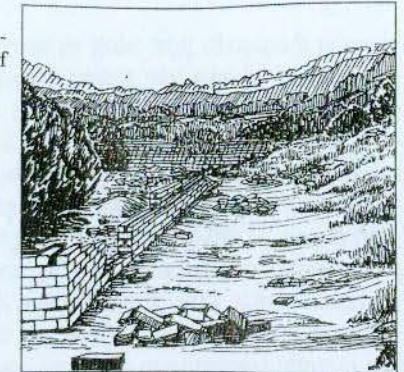


Fig. 8.5
Unstable bank.



Storm run-off:

- fills cisterns (valuable);
- clears debris from water courses (useful, but man-made debris may be damaging in the sea);
- allows debris to dog in constricted places and cause floods;
- removes some of the accumulated salts in the soil (useful, but takes them to the watercourses or sea, where they are damaging except for salt itself, in the sea);
- takes away top soil (damaging initially, as well as polluting and troublesome to watercourses especially impoundments and the seas);
- washes away dams, walls, roads, buildings (damaging, but damage is often enhanced by improper construction and maintenance).

It is, perhaps, unfortunate that the Government provides compensation to farmers for flood damage. This means that there is no financial pressure

- to make walls strong (with flow holes to take the storm water without damage)

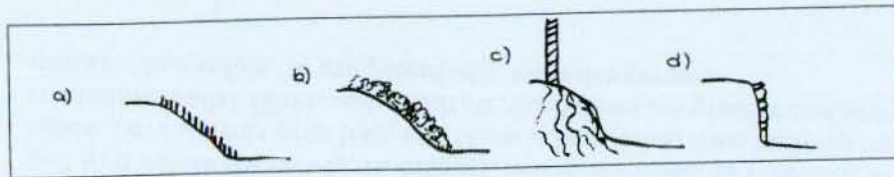


Fig. 8.6
Decreasing bank erosion.

(a) Even, short sward of e.g. grass, with roots that bind but not crack the bank, and nothing sticking out to catch in flow (b) Covering of bramble (*Rubus ulmifolius*) (c) Bank bound by roots (d) Walled.



Fig. 8.7.
Unsatisfactory erosion protection, Wied Ghajn Rihana. Water flow passes under road, then parallel to it; concrete poured on beside the road, destroying habitat. Channel should have been dug out, and walled on vulnerable parts.

- to avoid putting farm buildings on river beds,
- to make and maintain proper flow channels in wieden
- to direct storm flow where least soil will be eroded.

Sheet flow and gully erosion are the most damaging to the land, losses of over 2.5 cm of soil being recorded. Those farming on wied beds, of course, take the washing away of crops or soil as an accepted hazard: the high yields from the good soil in most years compensating for the occasional loss.

An obstructed flow gives the most flood damage in and by the wied. Obstructions increase the head and force of the water (Fig. 8.2), and may be gates, grids, rubble, buildings, over-high dams, walls, blocking shrubs, trees, *Arundo*, etc (Fig. 8.3), all of which not only obstruct flow, but prevent the passage of movable debris (like rubbish, dead livestock, fallen branches etc) which then increase the obstruction. Floods inevitably bring some debris, torn off by the force of the water from land or wied. It is wrong to

Fig. 8.8.
River tarmacked, bank replaced by modern wall. No river structure, habitat, aquatic vegetation or heritage.



Fig. 8.9.
Defensive moat, Zebbug (Haslam, 1991).



increase these already dangerous obstructions by leaving rubbish etc in the wieden.

Removing a flow path means that when floods arrive they will find and make their own flow paths (e.g. Lower Ghazel, Chapter 12) and these will not necessarily be where the flow causes least damage. Erosion is increased on unstable banks (Fig. 8.6) and in places where excavation or digging has left banks of unsuitable angles or not properly protected by vegetation cover. Fig. 8.7 shows some ways of decreasing bank erosion. These include properly maintaining any walls; suitable angles to earth banks (flatter for sand than for clay); vegetation made up of species binding soil, and offering a reasonably smooth passage to water (e.g. some grasses, various trees, shrubs such as briars, *Rubus ulmifolius*). Species rooting so as to crack clay soil are to be avoided. Thin spreading roots are good. Easily uprooted plants growing high above the rest should be avoided, because if these are washed away the hole left can easily get bigger, and bigger. Trees like the poplars at Chadwick Lakes are safe in all but the worst floods, as the trunks offer little resistance to flow, and uprooting is most unlikely (and see Fig. 8.8).

When part or all of the valley floor is a road, especially if asphalted or concreted, water can easily flow along this. However, given the speed of erosion of roads in Malta anyway, this may not be a long-term proposition and so is of doubtful cost-benefit value for flood relief. For conservation it is the worst possible solution, all natural and historic value being lost (Fig. 8.8). Watercourses may be walled for protection in flood (to prevent bank erosion or riverside flooding) or just for making boundaries. Since water runs downhill, there must be holes in or under walls to allow run off water to reach the watercourses (sometimes known as weeping holes). Walls may also be built in valleys to trap soil to prevent it being washed down. Walls may be across the valley floor, along the valley floor (Fig. 4.1) and on the valley slopes. Soil level is higher above the wall because of storm-soil collection (rather than, as when terraces are made, because the soil has been set there). Soil-trap walls sometimes make walled orchards (e.g. Liemu, Rum, Bowen-Jones *et al.*, 1961). In general, on wide valley floors, part of the floor may be left as a watercourse, or a new channel may be dug, or there may be no protection from flood flows for the crops on the bed.

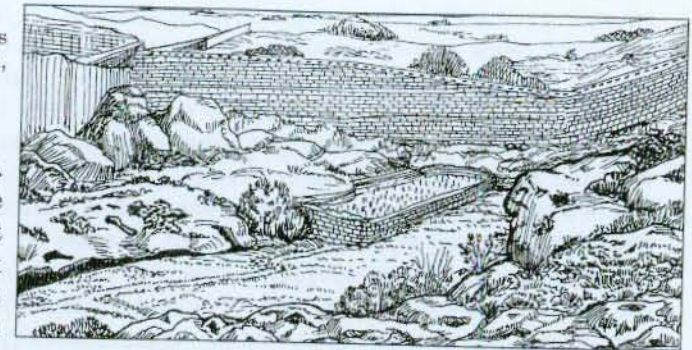
Dams, like bridge piers, create turbulence in flow, and turbulence is more damaging than smooth flow. Bridge piers in Malta have either been built to withstand such turbulence, or have gone: falling bridges are, correctly, not permitted. Dams, however, are allowed to break without repair, and paved "Good Luck Scheme" ones are especially vulnerable, some breaking up at less than 15 years of age. Turbulence, therefore breaking, is most on the downstream side of the dam.

Defence

As widien were (and are) means of communication, raiders as well as islanders could use them to reach settlements.

However, moats, rivers and ditches have always been valuable for defence (e.g. Valletta, bounded by the sea on three sides, a prisoner-made ditch on the fourth). If attackers have to go down in level before reaching their target, the defenders, standing above, can easily send down anything from boiling oil to projectiles. The attackers then have a difficult climb up, and the defenders an easy task of pushing away ladders and men holding on to the cracks in walls. Water in the ditch (moat, river) greatly helps the defence. It is slow to swim or wade through deep water. If the water has only just been taken away, the soft deep mud left may be even more difficult to

Fig. 8.10
Defensive lines across
valley, Dwejra (Haslam,
1991).



cross. Zebbug (Fig. 8.9) made good use of its river: it is not at all easy to attack the village from the river side. Mellieha is placed above the

valley, again a good defensive spot (alternatively, Mellieha can be said to be sited on a hill, so not properly included as river-defended).

Defensive walls can also be put across valleys. In Malta these are minor: the Victoria Lines and the Dwejra Lines (Fig. 8.10). However, really defensive walls have been built in other countries, e.g. Hadrian's Wall in northern England (Roman Empire).

Crime

In the larger, more gorge-like widien, when there were more trees and less cultivation, bandits, petty thieves etc could live in cover in woods without attracting attention. In more recent times it could happen only with the connivance of local farmers, and now, even with that, it would be possible only for short periods (cover is too little, and population, too great).

In the South, in the lower part of a rocky valley leading straight to the sea, is a small cave ideally placed for a fire within it to give a leading light far out to sea: a light along a line, which, if followed in, would bring a boat precisely to where smugglers could wait.

Explosion

Fireworks factories have little Health and Safety control as yet, and so, for fear of explosion, are sited away from other houses and are very clearly marked (with red bands). In order to be away from settlements, many are on valley sides.

9

FLOWING WATER, HOLINESS AND CHAPELS

*All ye who hither come to drink; rest not your thoughts below
Remember Jacob's well and think; whence living waters flow*
English holy well

(This uses two meanings of "living", that of flowing or running water,
and that of alive).

Holy Waters

Two numinous (inspiring awe, as in the presence of God) features of this world are the sun and drinking water, water from springs and streams. These supply the two necessities of life over which (until recently) people had no control. Skill and effort could bring food from even unpromising ground, they could bring shelter, clothes and warmth. No effort could bring the miracle of sunlight nor that of water. Both these were worthy of worship and ritual, that they might continue to sustain the communities they blessed. As is proper, they differed in gender, the sun being male (the reverence due being transferred, but continued in that given to the sun/Son of Righteousness), and the water, female.

Deities of water are in Europe almost exclusively female, and show favour to mankind. Water is essential for life, comfort and civilisation; and collection of domestic water, in Europe, was almost exclusively done by women; so the link between water and women is reasonable. The few male river deities were usually of large rivers, capable of killing by drowning as well as supporting life, like Ra of Egypt, who flooded the Nile plain to destroy his human enemies, but relented and withdrew the flood, leaving watered land with fertilising silt; and Deva, god of the Welsh Dee, a river hazardous to cross. Malta has no such large rivers, and early male associations with water are unlikely.

Malta is in the unhappy position of having large gaps in religious

history, and reconstruction must be by indirect rather than by direct means. The prehistoric temples were not by rivers, and though wells occur in them (as at Tarxien) it is not possible to say whether the water was holy, useful or both. The Christian record is satisfactory only from the late sixteenth century, leaving fifteen centuries largely unknown, including nearly three centuries of Muslim conquest. Even the Roman and Byzantine records are barely existent.

Against this framework, what can be deduced? The Roman Catholic Church uses holy water. To-day, this is water made holy by being blessed. It comes from any clean source, tap or rain: not, of course, now from rivers since contaminated water is hardly desirable. The holiness comes from the blessing, it is not intrinsic to the water. In Biblical Palestine, well waters were sacred, but almost only for their historical associations, like Jacob's Well, and later, the Virgin's Well at Nazareth. (The Bethesda pool at Jerusalem, with its intermittently boiling spring, was an exception: it duly had a supernatural element for the masses, though not for the priestly classes.) The lands later to become Muslim likewise had little holy water. Professor M.C. Owens states that desert wells, though sparse and vital for survival, were not friendly places. They could indeed be mysterious, with spirits of all kinds (including horses), but they were unpleasant (shifting sands make mysterious noises). The unpleasantness is surprising, given their importance!

In Europe, though, water was intrinsically holy, in spite of its being in ample supply in most parts of the continent. In the farthest and wettest west, for example, legend says that in Ireland (with a superfluity of water) wells broke forth on the birth of Christ. Water had holiness. Springs could break forth to mark a religious event, such as a martyrdom (e.g. St Erik of Sweden) or a vision (e.g. St Bernadette of Lourdes). Before land drainage, of course, the water table was nearer the surface and the sudden occurrence of a great weight of people at one place could alter the hydraulics, and hence create springs. Springs could intermittently boil and so be used for divination or healing; could shine at night (with luminescent bacteria) which appeared miraculous, could turn to "blood" (with e.g. the alga *Haematococcus*) which also appeared as miraculous and perhaps warning. All these could become sanctified: they were clearly numinous. Wells used by early holy men and women, pre-Christian or Christian, would be springs sanctified in the eyes of future generations.

Most such were pre-Christian, and there was a wise policy of christianizing these. "..... the temples of the idols in that country (England)

should on no account be destroyed. He is to destroy the idols, but the temples themselves are to be sprayed with holy water, and altars set up.... In this way we hope that the people, seeing its temples are not destroyed, may abandon idolatry and come to these places as before; and may come to know and adore the true God". This was written by Pope Gregory in 601, for the guidance of St. Augustine of Canterbury. In consequence, in England holy wells abound (still). Many are at the boundaries of churches, the church having been built on a previously-holy site, and others are scattered around the country, 50–90 in a county being not unusual. These are, of course, predominantly with female dedications, most often to Our Lady, also to St Anne etc. Lady's Wells are frequent. This name, of course, meant Who the Lady was, remained indeterminate while Christianisation was continuing.

We therefore have a change in the nature of the holy water as used in worship. In the beginning, the holiness was in the water. Any blessing pronounced over it made no difference to its properties: it is reasonable to suppose that blessings were expected from the water. Now the water is nothing, the blessing is all.

This is symptomatic of the change in people's view of water. Far from being the symbol of purity, that which most upon earth, represents the purity of the divine, water is now the exemplar of man's pollution of the earth. Once St Hildegard could say the leaping fountain is clearly the priority of the living God, and St. Francis refers to sister water, precious and pure. Now water is contaminated by pesticides, road and urban runoff, industrial, farming and domestic wastes, fertilisers and many more. It is not just "Don't drink the water, child", it is "Don't paddle in the water, don't even touch the water, it is dirty and will make you ill". What a terrible change, dirtying the surface water, mainly in the last two hundred years, dirtying the underground water, mostly only in the last fifty years. Such wanton laying waste of the earth is already starting to exact its penalty. Much more can be expected to come. (Malta already depends on fuel provided by other countries to supply its tap water. If forced to be independent, disease and, presumably, much death would follow.)

Although Malta is most often thought to be part of Europe, there is an alternative view that it is really African. In terms of holy waters, it is interesting to relate, Malta is wholly European. Water here is friendly, holy and associated with the female. (Except, that is, for the word itself, "ilma" which is masculine, since the Muslim conquerors handed arabic to Malta, and the arabic word is masculine.)

Throughout Malta, Guillaumier (1972) lists 211 churches dedicated to females and 180 to males. This, compared to Europe in general, is an unduly high proportion of females, reflecting the strong Marian tradition in Malta (163 Marians here listed). That is, the female:male ratio is 54%:46%. The smaller samples of Kilin (1990) and the O.S. 1 : 25,000 maps have ratios very close to this. When looking at chapels associated with rivers or (still extant and large) springs, however, the female:male ratio rises to 17:3 and 11:2 respectively, or 85%:15%. This shows a highly significant association between water and the female, so strong presumptive evidence of the continuity of a pre-Christian religious tradition.

Since at least the times of Ancient Greece (so presumably earlier), young women have been seen by springs and streams: whether seen objectively or subjectively (and if objectively, swiftly vanishing mortals or immortals) who can say? But it is a persistent and well recorded tradition over, now, millennia. Water is holy, the Lady creates or partakes of that holiness. The interpretation of the Lady varies with period and culture: classical nymphs, both Greek and Roman, Anahita, goddess of the river Oxus, the Celtic Lady of the Fountain, no divinity but the Lady and mistress of the otherworld, with its magical happenings, etc.

With the passing of such beliefs, the Lady herself has not passed, but remains, usually within the ambit of the Catholic Church. (The Hungarian Woman of the Wells is an exception. Hungary is mostly Roman Catholic, but the Woman, though an immortal, is not Christian. She has been seen in the twentieth century (Y. Bower, personal communication).) The visions of St Bernardette of Lourdes are the classic example, well recorded and studied, and authenticated by the undoubted miracles following, as — unlike the nymph Egeria — the providence of Almighty God working through this phenomenon of the Lady. (As will by now be clear, it is possible to "see" the Lady without her being Our Lady.)

It is reasonable to suppose that some of the present river chapels are on sites where the Lady was seen. Only one is recent, however. Our Lady of the Assumption, Gharghur (Fig. 9.1), is where, in 1560, a maiden was cured of an illness, and built the (original) chapel as a thank-offering. Although there is as yet no chapel, the Madonna tal Girgenti, of the late 1980s, can be placed here also. A chapel on a site of pre-Christian holiness is enhanced (not diminished) by the knowl-



Fig. 9.1
Our Lady of the Assumption, Gharghur. A typical sized chapel on the flat land top above a gnien cliff (to the right far side of road). The chapel faces the springs as well as the road (Kilin, 1990).

edge that the site has been hallowed by prayer and worship for such a period of time.

The Arab conquest, from 780 to 1127 (the final expulsion of the Muslims being in 1249), had a doubtful influence on Maltese Christianity. The extreme view on one side is that Christianity was totally obliterated. This seems unlikely in only 250 years in a largely illiterate society (where word of mouth tradition is usually both accurate and long-lived). Surely at least legends of Christianity, and the location of holy places must have remained. At the other extreme is the view that the Arabs sacked the land and withdrew, leaving, therefore, religion untouched. In view of the change in cultivation (see Chapter 4), and in language, this also seems unlikely. In Spain and Palestine, to name well separated parts with Christian-Moslem conflict, the two had a habit of building on each other's holy places, not, it is to be regretted, in the spirit of reverence described for the pagan-Christian change in southern England, but more with unholy glee at stamping out — so

they thought — the evidence of each other's religion. Putting a Muslim cemetery over a Christian Roman Villa in Rabat seems in that tradition. Evidence is lacking on overbuilding of churches and mosques, (soil is shallow, and foundations of simple buildings are easy to remove).

It is not part of the Muslim religion to see young women by water. If anything of the sort happened, it would, according to Professor M.C. Lyons, be disapproved of as being both spirits and females. By fully Islamic times the well spirits, whatever they were earlier, had become "djinnns". Therefore the association, in watery places, of holiness and the female in Malta owes nothing to Islam, but is Christian and Christianized.

However, even though most countries had wells into which children could fall, the Belliegha monster (well-ghoul) lurking within wells which could eat such children is not usual. The guardian spirits were, as mentioned, usually kindly. Are the Maltese Belliegha perhaps the descendants of djinnns, changed over the years from being powerful to being just a story to frighten children?

The well-ghoul is *il-Belliegha* (the one who swallows). An eel was commonly kept in the well of each house, even to within living memory. This ancient practice kept the well clean and provided the ripples for the well-ghoul (see chapter 12).

Holy springs (holy wells) are now hardly found. It would appear that this tradition was lost, rather than it never existed. There are still holy springs in Gozo, the water being used, with herbs, in illness. The cave church of St Paul the Hermit (River Ghasel, Fig. 9.2) is in the larger outer cave. Inside is a second cave with a spring, a natural water basin (showing the water was long collected) and an early picture of the Madonna (Kilin 1990). Even here, therefore, where the dedication of the present chapel was to the male patron saint of the country, the tradition of the female and the water persist. The Grand Master of the Knights of St John of Jerusalem took water from the cave (Guillaumier 1972, Kilin 1990). Why? The writers have not traced it, but surely there must have been something very special about the spring. Some form of holy spring, undoubtedly. Perhaps fully Christianized, bringing blessing; perhaps less so, bringing power over the land?

Near Mistra, the Apostle's (Paul's) fountain (Ghajn Rasul), is now closed as unfit for drinking. This is near the coast on the old road north, and its inscription states "the small spring beneath the stone on the coast was opened by St Paul the Apostle, those who pass by salute it with your

hearts, while remembering it was brought forth by Paul who was saved from drowning". This suggests a spring created by a crowd (see above), with water considered holy on historical grounds. Remnants of Roman baths in the area show springs were good. Obviously, a late story (probably after the arrival of the Knights of St. John of Jerusalem, and not before AD 59). How many more examples wait to be published? The European tradition, and the chapels in caves (caves so often have or had springs) make it likely they were common, but without proof.

The legend of the chapel of Our Lady of Carmel, outside Siggiewi (Fig. 9.3), is instructive. A substantial spring rises in a tunnel under the present church, so a legend about a Lady, holy springs, a martyrdom or the miraculous powers of the spring water would be expected. Instead the spring broke forth during a drought in response to a prayer and vow for water (Kilin 1990). This is not a typical story, and perhaps would be a secondary, later one (to perhaps explain what was no longer culturally acceptable?). It is only small springs that break forth with earthly events. Large ones pre-date such events, though similar legends may become attached to them, e.g. near the traditional site of St Paul's martyrdom, outside Rome.

The Christian church has too often objected to women having any responsibility. In traditional societies, women are the primary carers of the sick, and have the primary association with water. In the sixteenth century, the Malta church banned washing the sick in holy water (cleanliness, in dirty centuries, seldom did harm) and herbs (probably the best available medicine) while reciting prayers (Cassar, 1964). This banned (but no doubt reasonably effective) treatment would have been done by women. A later (allowed but presumably less effective) water treatment was to be dipped in a special bath on Easter Sunday. This was said to be good against the ill-effects of frights, and to encourage babies to walk (Cassar 1964).

River Chapels

St Paul the Hermit (Ghasel, Fig. 9.2) is of interest in several respects. The four pictures chart stages from the nineteenth century: (a), to the deplorable present state, (d). The evidence for the loss of water is well demonstrated (see Chapter 2), the river-worn lower stone of the still-recent channel showing quite clearly below the drier valley above. The pathway



Fig. 9.2
St Paul's cave church, Wied il-Ghasel.

(a) Above. Nineteenth century print.

(b) Right. 1950s (Bowen-Jones et al., 1961).

(c) Below. 1970s (Kilin, 1990).



above the valley bed shows this also. The legend (in Kilin, 1990) sounds Celtic, with a male hermit producing the water, quarrelling with the folk of Mosta, and sailing away in a huff on his cloak (if Celtic, this is in a coracle lined with his cloak skins). Attendance at this chapel — which is quite a walk from Mosta — decreased after 1761 when the Speranza chapel was built (see below). In 1920, the path was repaired, and other improvements were made. Subsequently, British engineers

Fig. 9.2 (cont.)

(d) and (e) Right. St Paul's cave church, Wied il-Ghasel 1992. After 9.2 (a), much water has gone, the path has gone and loose scree is on the slope (see text and Fig. 8.5), which is later colonised by plants; disturbance on the floor has increased; the bed has changed; in (e), note the river-worn bed with rain-worn rock above.



opening passages to ammunition stores in the caves and underground dug-out stores allowed scree to form and fall, knocking out the path. That damage was followed by that of boys, then by adult vandals. Rock falls from the cave roof did further damage, including to the path, in about 1970. Up to this time, the chapel roof was sloped, unusual for a Maltese chapel, but after a further rock fall through the roof, it was rebuilt flat (partly from Kilin, 1990). More was to come. The quarry on the opposite side of the gorge uses explosions with enough vibration to cause yet more rock falls. (The pink areas of rock

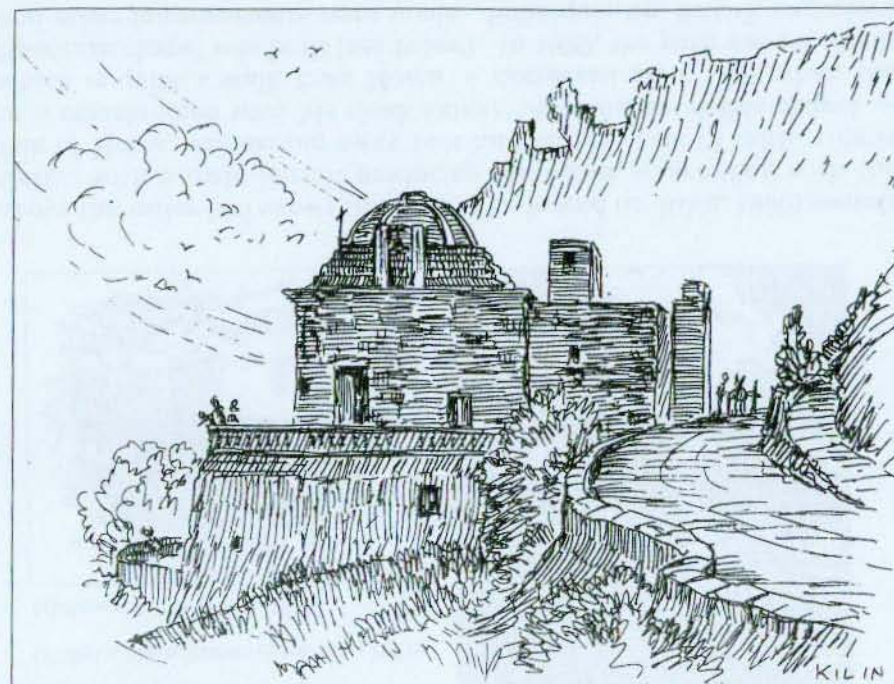


Fig. 9.3

Our Lady of Carmel, Fawwara, Siggiewi. On a rocky slope in a gnien area (Kilin, 1990).

show modern falls.) This is the only full-size chapel actually within a cave in a valley wall.

A group of chapels perch on the side of steep, rocky but not vertical valley sides, e.g. The Annunciation, Lunzjata, Gozo (Fig. 9.4), Our Lady tal-Patrocinju, Gozo, St Anne, Pwales, and Sta Katarina, Ghasel (Fig. 9.5). Some, at least, have or had springs. The original holiness would have been in the spring. It is now transferred to the chapel: even those living near may not consider the well as holy. The poem (by G. Zammit) at the start of this book describes a chapel and flowing spring on a slope. Another group of chapels are just beside rivers which are not in valleys, i.e. are on flat ground by the rivers, e.g. Sta Margerita, Ghasel (Fig. 9.6); San Blas, Kbir; Sta Marija, Sewda (Fig. 9.7) (the one by the river, not that of the same name in the town centre); St. Paul's Shipwreck, Ghasel (Fig. 9.8) (the Seamen's Rest, see below). These are all river chapels, they are close to the river, and



Fig. 9.4
The Annunciation Chapel, Lunziata, Gozo. Perched part way down a cliff slope. (Kilin, 1990).

associated with that, even though there may also be springs from the valley side.

The next group, though, are gnien chapels. These are found on the flat tops above gnien limestone cliffs or slopes, with the typical gnien springlines below. The Assumption, Gharghur (Fig. 9.1), whose story has been told, belongs here, so does Our Lady of Victories, Mtahleb, the Annunciation, Liemu, the Immaculate Conception, Kuncizzjoni, and, roughly, Our Lady of the Way, Bingemma (Fig. 9.10). It is also possible for chapels to be at the bottom of gnien slopes, as Sta Marija Maghtab, Gharghur. Our Lady of Carmel, near Siggiewi (Fig. 9.3) is also on a gnien slope. The Sanctuary at Mellieha is built over a sacred Grotto. The fresco of the Madonna is old, by legend painted by St Luke.

At Salini, the Annunciation (Fig. 9.11) and St Michael's both perch above what was the Ghasel marsh (largely freshwater) and, earlier, the port (sea water) so, though sited as salt-water chapels, they may also be



Fig. 9.5
Sta Katerina, Ghasel. On a quite steep (but not here rocky) slope, of the Ghasel valley.

included with the river chapels.

Several may be singled out for special mention. The original Annunciation Chapel on the Liemu was cut in a cave with a rock bench and altar. In the Middle Ages it was probably dedicated to St Leonard of Limoges, patron saint of slaves: very necessary with so many slave raids on (and regrettably also from) the Island. St Lucy, Mtarfa, overlooking the Qlejgha, has many First World War *ex-voto* offerings. St Lucy is the patron saint of eyesight, and the Mtarfa Military Hospital housed many soldiers damaged by poison gas. Early Christian tombs occur near the Annunciation chapel at Salini, suggesting a long-continued link. Our Lady of the Visitation in Wied Qirda (Kbir) was used as a military post, from whence horseman could gallop for help to Mdina during pirate raids (largely from Kilin 1990).

The Chapel of Sta Marija on the Sewda (Fig. 9.7) was a Wayfarers Rest chapel. Sited in the river town of Qormi, on the road from the main harbour of Birgu and the capital, Mdina, it provided a resting place for travellers on business, or indeed perhaps pilgrimage. This is an example of one of the early functions of the church, to provide hospitality to travellers. In the small Island of Malta it is hardly surprising only a few remain, and presumably only a few existed. (Resting places would usually be needed only at the ports and the seat of Government, most other places being reached by day.)

Another traveller's rest, this time traditionally for seamen on pilgrimage, is St Paul of Wied Qlejgha which can conveniently be called the Seamen's Rest Chapel. It was on the route from St Paul's Bay or



Fig. 9.6
Sta Margerita, Ghajn Rihana, Ghasel. On near-flat ground near the watercourse, and set a little way back from it (Kilin, 1990).

(earlier) Salini Port to Mdina and its shrines, and (see Fig. 9.8) was built so that it faces the wied, looking downstream to welcome arriving seamen. This is quite specific: there is a land entrance, but it is small and undignified. The main entrance is on the river. Looking from the steps, they are sited just above the river-worn stone of the river bed, i.e. above where there was much water. Seamen could have walked up in low or middle water, come by cart or e.g. mule, in middle or higher but



Fig. 9.7
Sta Marija, Sewda, Wayfarer's Rest Chapel. On near-flat ground near the watercourse, and set a little way back from and facing it, formerly within a fortified, protective wall.



Fig. 9.8
St Paul's Shipwreck, (Seamen's Rest Chapel) Wied Qlejgha, Ghasel. On the flat land beside, but built into the watercourse to welcome and receive sailors coming up the wied.

not swift water, even by barge in high (not swift) water. When water was too deep or swift, seamen

could have travelled beside the river, or direct, rather than by the route of the Ghasel to the far side of Rabat. On this chapel (Fig. 9.8) are engraved pictures or graffiti of ships, of various dates and sizes, presumably those for which the seamen wished to return thanks, or pray, for safety or prosperity. (Similar ship engravings are to be found at the churches of the Immaculate Conception at Kuncizzjoni, Wied Gerzuma, and Qala, Gozo.)

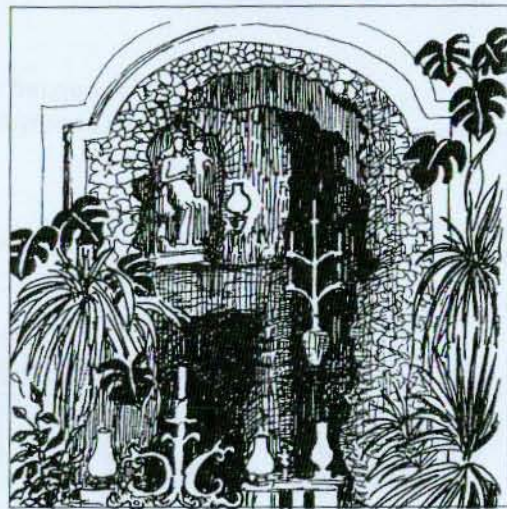
Downstream of the Seamen's Rest, between this and the cave church of St Paul the Hermit, is Our Lady of Good Hope, Mosta (Fig. 9.9). This (Speranza) bears the same name as the section of valley in which it is sited. There is a genuine cave in the valley wall, transformed to an artificial

Fig. 9.9

Our Lady of Good Hope Chapel, Mosta, Ghasel. Artificial grotto created in the cave in the valley wall of the (low) gorge, with a church above (Haslam, 1991).



grotto with statues etc., and with a chapel built over it, on the flat top of the gorge. This dates from 1760, and being more accessible, drew many of the people formerly attending the St Paul the Hermit chapel. The associated legend is that a Mosta girl took refuge in the cave from raiding corsairs. As the closest cave — and with a spring — to the main town of Mosta, worship here surely much pre-dates that event (or legend). The shape of the roads here shows regular ancient passage to the site. Above others in Malta, this chapel was, in the late nineteenth century, linked to Lourdes and St Bernadette's vision of Our Lady of the Immaculate Conception. The days of the Lourdes appearances are celebrated here regularly. This was an obvious church to pick. It had a proper cave. It already had a dedica-



tion to Our Lady, unlike St Paul the Hermit. It was close to a main town, unlike the Annunciation Chapel on the Liemu (with its awkward previous male dedication), and various other then very remote cave churches, (e.g. along the south of the Island). There could have been a third reason. This was an old way from Mosta to the river. Refuse, until, probably, late in the nineteenth century, was disposed of by being thrown into the wiede, to be carried to the sea by the river water. Was this the site of the tip? The vision at Lourdes was at the rubbish dump. (Rubbish is of course still thrown into wieden, but not, normally, of the household garbage and night soil variety.)

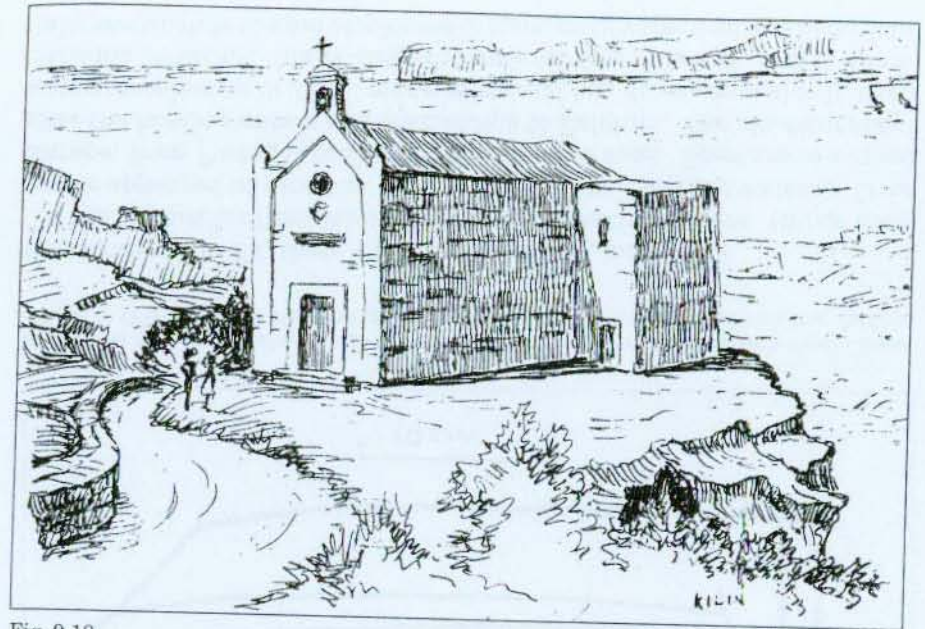


Fig. 9.10

Our Lady of the Letter Chapel, Wied Bingemma. On a gnien rocky slope (Kilin, 1990).

The historical basis of churches is, as already implied, bad. There is a presumption of early Christian worship in the first century, but no evidence whether this was in houses or in buildings set aside for the purpose (churches). Christian burials exist. The Roman period was followed by a Byzantine one. The uncertain effect of Islam has been mentioned. Up to 1575 evidence is deplorable. A few churches, like the Annunciation, Liemu, are earlier (fourteenth century for sure, maybe eleventh century or earlier), and the Annunciation, Lunzjata, Gozo (fourteenth century at least). The earliest good evidence is that of the Visitation in 1575, which noted churches, their condition, their status, and any recent history. Since then, records are generally satisfactory but satisfactory for the questions ecclesiastics need answered, not for details such as the last date of seamen arriving at the Seamen's Rest. Worship does, of course, continue for centuries in broken-down huts, once these are established as holy places (and therefore preferable to houses), and given the chequered history of Malta before 1530 and the Knights of St John of Jerusalem, it is probable that churches would



Fig. 9.11
The Annunciation Chapel, Salina. Above the salt pans and flat plain (ex-Ghasel marsh, export of Burmarrad) (Kilin, 1990).

have been destroyed and rebuilt many times (and not rebuilt in a grand fashion likely to attract the particular attention of raiders).

Healing Waters

As well as bringing blessing for the soul (and pre-Christian, other supernatural attributes), special waters have brought healing for the body. Here different elements must be separated. Firstly, clean water was a cure for many ills in the days when washing was almost non-existent among Europeans. (Cleanliness was important in classical times, and the Roman traditions of much water and cleanliness were maintained in the religious establishments founded by, say, St Hildegard of the Rhine and St Bernard of Cluny). Sore eyes are now an uncommon complaint, but the number of English holy wells reputed to cure them indicate their former frequency and suggests pure water alone was efficacious. Secondly, change of diet, air, water and society while on pilgrimage could effect cures attributed to

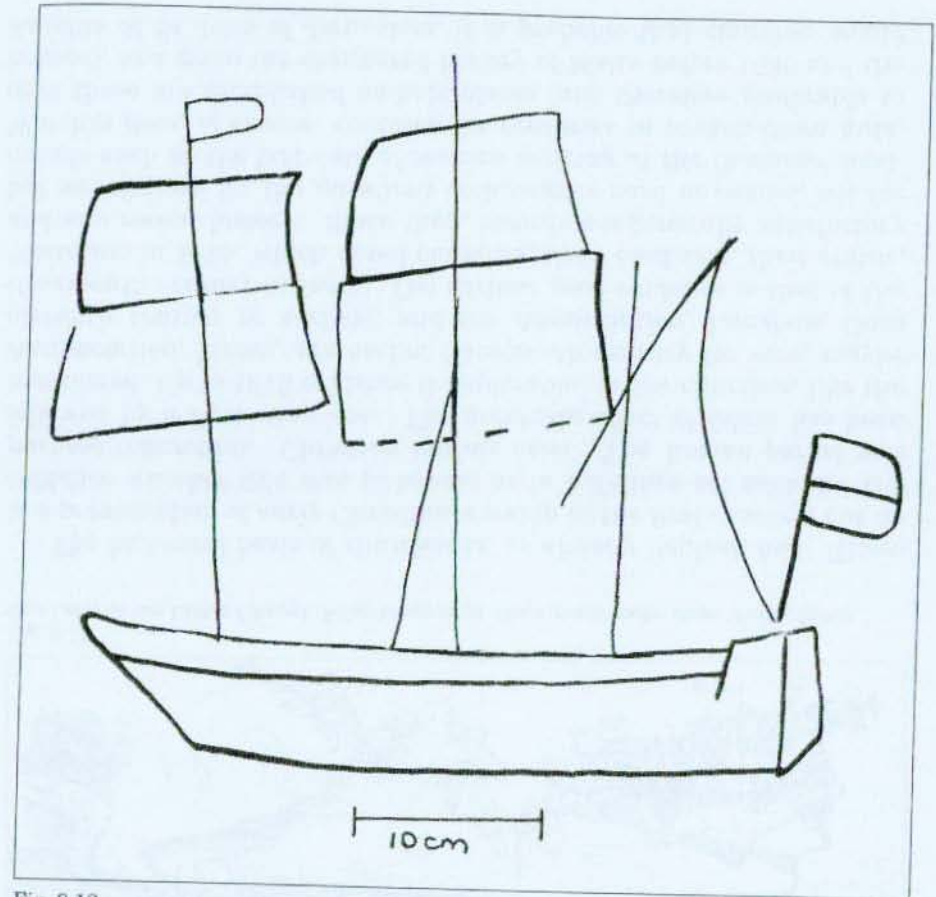


Fig. 9.12
Above and next page. Carved ships on wall of St Paul's Shipwreck (Seamen's Rest) Chapel (Fig. 9.7). (Figs. and text kindly supplied by J. Muscat). See text annexed with this chapter.

the shrine. Thirdly, there was fraud; fourthly, miracles.

Lastly, but far from least, there are the healing waters. (Since their power appeared miraculous, they usually started as holy waters.) Over Europe, from Portugal to Eastern Europe, are spas. Spas are so-named after the healing waters and town of Spa in Belgium. The constituents of waters ameliorate or heal many ailments, but do so more slowly than orthodox medicine. Many large continental firms, though, find it financially worthwhile to send employees to spas, money spent on fees being less

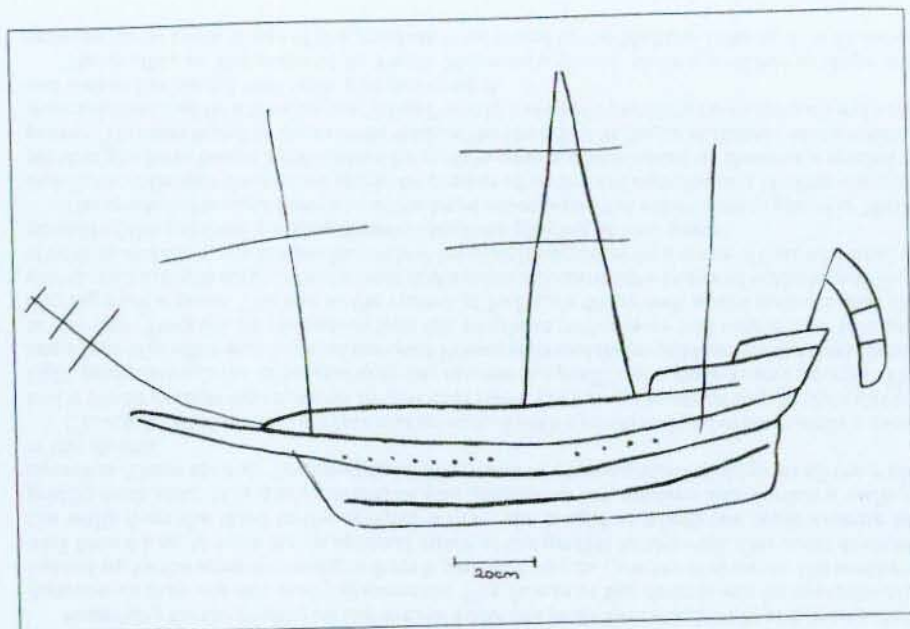


Fig. 9.12 (cont.)

than that lost by illness.

The prehistoric temples in Malta do not appear to have baths as important parts. The Romans, who went in for healing waters in a big way, certainly used Ghajn Tuffieha and Marsaxlokk, and the remains of a system to heat water were found at Marsaxlokk (Guillaumier 1972). The Roman culture included Public Baths. There are no Malta records of hot springs, or healing springs. In Malta, absence of records is far from final, but if there were healing waters, surely the Knights of St John of Jerusalem, coming, as they did, from countries with many spas, would have found them. In Malta, therefore, water has no healing power, save that coming from keeping clean. (The Corinthia Palace Hotels at Attard and St. Georges, however, advertise their spa facilities — meaning they offer saunas etc., among various treatments. This twisting of the meaning of "spa" is, regrettably, spreading.)

In Malta, the holiness of water has been lost down the centuries. Water is no longer numinous. Blessedness is conferred by the church — but could just as easily be conferred on petrol or cabbages. The only remnant of the numinous is that it is water that is blessed, not carrots.

In Malta the purity of water has been lost over the past one and a half centuries. Not just river water, but much spring water too is unfit for drinking (see Chapter 5). Tap-water, that nineteenth century cure for all the many water-borne bacterial ills of Malta, is no longer chemically safe. Increasingly even officialdom recommends bottled water. Bottled water is recommended not for its divine powers, not for its healing powers, not even for its purity (leading brands were above European Union levels of nitrate) but as being less harmful than any other form of water to drink. Less harmful! What a short step from the sublime to the corrupted.

Annex (see Fig. 9.12)

The small rural church of St Paul's shipwreck, sited on the outskirts of Mosta, is known also as tal-Mingiba. It was built c. 1690 on the site of an abandoned earlier small church, but unfortunately there is hardly any information about it. The present church was blessed by the Rev. Don Ferdinando Castelletti on 9 February 1695 and it is known that a new cupola was added some time later in the seventeenth century.

It seems that there is some difficulty in tracing the provenance of the property of the church. While the parish of Mosta maintains that it has the right of jurisdiction on the small church, the Cathedral chapter of Mdina claims it. At present it is being opened daily for the sacred services and it is frequented by the local people living round it, mostly farmers.

The masonry work is in excellent condition. The building stone from the *Globigerina* layer was quarried from the vicinity of the church and has withstood the ravages of time quite well. It is sometimes said that when the local stone is utilised near the place where it was quarried it would probably last much longer than when it is used for buildings a good distance away from the quarry. The St Paul's Shipwreck church is probably the only example which is equipped with some benches rounds its interior walls. The decoration of the walls is kept to a minimum and perhaps the use of paint is undesirable on such an old rural church. Luckily the exterior walls were never affected by any type of restoration. The modern electric wiring and lighting on the facade are highly anachronistic.

The facade and the northern wall of the church are excellently preserved and show a grey-green patina of lichen. The space between the small stone blocks was kept to a bare minimum and is a credit to local craftsmen. There was hardly any need for painting and after three hundred years these two walls can be rated as being in good condition. No plastering or whitewashing has ever been applied on the walls and that facilitated the evaluation of the genuine graffiti executed on the church walls up to the nineteenth century. It is interesting to note that the church is partially screened on its southern, western and northern walls by a bridge; that may have contributed an amount of protection from prevailing wind conditions and air pollution from modern traffic. The church is sited on a lower level than the main roads, a condition which might have helped the preservation of the stonework.

The St Paul's Shipwreck church at Wied il-Qlegha offers an interesting case study about graffiti. The religious cult of "offering" a graffiti or *ex-voto* is widely diffused in Malta and Gozo. It has been noticed that the greatest number of graffiti are found mostly on small rural or wayside chapels rather than on the greater parish churches. At the Tarxien Temples one finds the oldest graffiti in the Mediterranean dated c. 1600 BC. But the tradition continued in classical times and in the paleo-Christian period and appeared again during Byzantine times and the early Middle Ages. After the arrival of the Order of St John in Malta the building

of churches flourished greatly and in the same manner the cult of graffiti offering spread rapidly to all churches. One may assume that the Maltese have a vast tradition if not the longest of graffiti offering in the Mediterranean.

Graffiti are accepted as *ex-voto* offerings, especially those executed on holy places such as temples and churches. It has been observed that the interior walls of some churches were utilised also for graffiti. It is believed that some mariners preferred to offer graffiti as they were most likely to survive much longer than *ex-voto* paintings. The donor had the privilege of tracing his own symbol on stone while an *ex-voto* painting was generally executed by professional *madonnari*, or painters. There were various motives which prompted a "donor" to inscribe a graffiti on a church wall. A good number of such graffiti were expressions of thanksgiving after a dangerous experience at sea but there were others which might have been "donated" prior to embarkation, in the case of ship graffiti, as a sort of "good luck" for a journey.

The church of St Paul's Shipwreck is endowed with a relatively great number of graffiti, the great majority of which represent sailing ships. It has been observed that in Malta and Gozo ship graffiti are found everywhere on internal and external church walls, prison cell walls and fortifications. One may ask why ships were so popular as a graffiti symbol. But one must remember that people, being islanders, sought their livelihood on the sea as fishermen, corsairs or sailors from antiquity and that may explain the popularity of such a symbol.

Apart from the good number of ship graffiti, the St Paul's Shipwreck church shows other symbols such as the upraised hand, a bird, a game, a possible design of a sheaf of grain, pittings on ships, the eight-pointed cross and perhaps other minor representations of dubious origin. There are at least fifteen graffiti on the facade or western wall and seventeen on the northern wall. Pittings on Maltese graffiti are particularly interesting as they are not likely to represent gun or oarports on ships. They are most probably a decorative element with a possible link with the Maltese custom of decorating stone slabs and altars of ancient temples. Such pittings were easily executed and are found on many Maltese graffiti of ships.

Searching for the graffiti on the church walls one must look attentively and from a close distance as they are not easily discernible. The facade of the church will be exceptionally lighted up by the summer sunlight from 5 p.m. to 9.30 p.m.; one must examine the northern wall from 9 a.m. to noon for an optional vision of the graffiti on the wall. One must examine the walls from the third to the seventh course, the height at which one could execute his graffiti with ease. It is quite normal to find graffiti on the western and northern walls of churches. There are only few exceptions where one can trace graffiti of ships on all the walls of the church.

Unluckily the threshold surface was smoothed with a powertool and consequently a game and a pitted graffiti disappeared in that operation. On the upper stone step to the extreme right going through the main entrance one can see the graffiti of a game known as *trija*. The same type of graffiti was found at the Gozo Prison cells and in the cell floors of the Castellania in Valletta. They are an indication that the people at such places had ample time to waste playing such a game. The one at the church of St Paul's Shipwreck might indicate that the church and the immediate area in front of the main entrance were endowed with the privilege of asylum and there might have been a law-breaker living there for a space of time who availed himself of the privilege passing some of this time playing at that game.

The symbol of the uplifted palm of the hand repeats itself in various other places in Malta and Gozo. Although the symbol might be compared with Carthaginian and Muslim customs yet it might have been Christianised by certain people and adapted by them as a symbol of prayer. The ones found on the interior walls of the church of St Roque at Balzan most probably were not inscribed by a Muslim, no "infidel" would have been permitted to enter such a church and deface the sacred wall with a pagan symbol.

The graffiti on the walls of St Paul's Shipwreck church show a number of ships and amongst them there is one of the greatest to be found in the Maltese Islands. It is found on

the facade, to the right of the left pilaster of the church. Other ship graffiti show a galley on the northern wall as well as lateen rigged merchant ships. There are several lateen rigged ships but others are hardly identifiable.

One can assume that the graffiti on the church walls are genuine, considering that there were few superimpositions of modern graffiti. Each donor respected the graffiti of his predecessors and one will notice how, in general, the whole surface area of a stone block was employed to inscribe one ship graffiti only. But, of course, there are instances also when a graffiti was spread on more than one stone block surface. Fortunately the church of St Paul did not suffer much from the modern vandalic acts. Modern graffiti are easily recognized because they cut through the growth of the lichens, deep incisions are used and mostly they represent initials of those who wanted to leave their mark on the stone.

The stone on the northern wall is suffering from weathering, starting at the first and continuing to the fourth course. Unfortunately the decay seems to be affecting the rest of the wall, but only the lowest course. The facade is in a better condition of preservation although there is a trace of weathering at the base of the left hand side pilaster. The grey-green patina produced by the growth of lichens on the facade of the church is a unique characteristic.

The graffiti themselves are in a good state of preservation although in a few cases they have faded, few are superimposed by modern vandals and others are partially covered by the growth of lichens. Remembering that graffiti were never intended as a decorative element one must look carefully at close distance to discover them. The incidence of the sunlight on the walls is of utmost importance to highlight the outlines of graffiti. A brief description of each graffiti might be found useful for a better appreciation of this Maltese cultural and religious cult. One cannot exclude the participation of foreigners as possible participants in such *ex-voto* offerings, as has been observed in the study of other sites where graffiti were discovered. It will be observed that most of the attention will be concentrated on ship typology and identification, as their presence is much more numerous and important than any other symbol.

One must look objectively at graffiti without attaching subjective interpretations. Graffiti show basically the main lines of a ship and quite often they lack the representation of rigging. While suggesting a possible nomenclature for a ship one must not imagine details that cannot be deciphered in the graffiti. The donor of a graffiti was interested to imprint devoutly his mark on stone and not to execute a work of art or to trace a technically correct representation of a ship. **Do not touch or alter these! They are valuable. Leave for future generations.**

10

THE CONSEQUENCES OF NEGLECT

Any nation concerned about the quality of life, now and forever, must be concerned about conservation. It will not be enough to merely halt the damage we've done.

George Bush

Neglect overlaps with deliberate damage (Chapter 11), and the division between them here is arbitrary.

1. Loss of Spring Water

Although spring water is intentionally taken for farming and domestic supply, the consequences of this abstraction were not intended, so this damage factor can be placed here. Spring water is very much less, and most spring water now does not reach the rivers.

2. Loss of rain run-off water

This was even less intended. Constructing so many roads with, generally, no provision for run-off to be cleaned and go to the river, diverts much of the rainfall water from the river.

3. Loss of aquatic and marsh flora and fauna

Less water means less water habitat, so less plants (such as water crowfoot, *Ranunculus*) and animals (such as tadpoles, water boatmen) of that habitat. The loss has been in the total quantity of aquatic life, and in the loss or near-loss of some species (see the Red Data Book). Loss of species also includes a scenic loss, a loss of wetland outstanding natural beauty.

4. Loss of aquatic habitat from dams

The act of damming and removing the water collected is deliberate, but those doing it were not intentionally:

- (a) turning a flowing habitat to a still-water habitat;

The Consequences of Neglect

Fig. 10.1
River bed overgrown

(a) By *Arundo donax*.



(b) By woody plants.



- (b) shortening the total length of winter-flooded river;
- (c) dredging so ecologically badly that much flora and fauna are lost (by direct removal of propagules, by loss of diversity of habitat, by permitting smothering silt) (see below);
- (d) giving water too deep for many aquatic species;
- (e) causing many deaths (animals and plants) by, often, suddenly removing all water (instead of slow drying allowing development of resting stages).

5. Lack of maintenance of wided vegetation

In the past, vegetation was kept clear by one or more of



Fig. 10.2
Retaining walls broken,
Wied il-Qlejgha.



Fig. 10.3
Dam broken.
(a) Downstream erosion. Good Luck Val-
leys Scheme (1980s) dam.

- (a) scouring flow;
- (b) heavy grazing;
- (c) use for communication (walking, carts etc.).

With little or no maintenance and use, vegetation can grow larger.

6. Flood hazards from vegetation overgrowth (Fig. 10.1)

Drier channels and no (or inadequate) vegetation control lead to beds choked with plants, *Arundo donax* in damper places, shrubs, trees and other tall plants in drier ones.

Fig. 10.3 (cont.)

(b) Upstream collapse.



Fig. 10.4
Soil erosion and gullies.
Should have been re-
paired immediately.



7. Failure to repair crumbling retaining walls (Fig. 10.2)

Soil then slips into the river bed, massively in severe floods. Top soil is lost from the land, river beds may be choked.

8. Failure to repair broken dams (Fig. 10.3)

This is principally, but not only, the recent paved dams of the Valleys Good Luck Scheme (Risq il-Widien). Dams which are badly broken do not retain water.

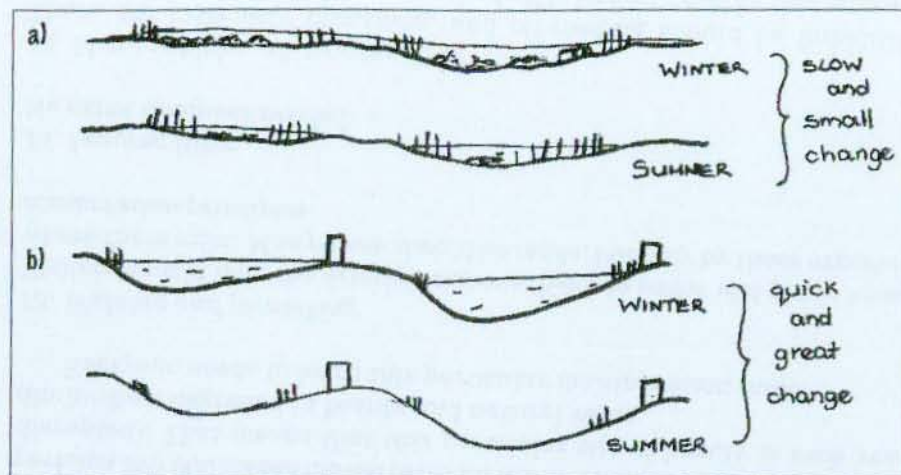


Fig. 10.5
Aquatic community loss through damming, diagrammatic. (a) Before damming and before water loss. (The lower Fig. resembles the present winter habitat; the present summer habitat is dry; there is now more tall and less within-water vegetation, as in the Wied il-Ghajj Rihana.) Fig. 10.1 River bed overgrown. (b) With dams, water can be removed in as little as one day, perhaps more than once in the season (some dams have water removed slowly, and water may be left until late in the spring).

9. Soil erosion from lack of maintenance and care (Fig. 5.5)

Lack of walls, improperly placed walls and other boundaries cause increased erosion of the irreplaceable fertile top soil.

10. Unsatisfactory dredging and cleaning (see Fig. 10.1 above)

Impoundments are dredged to collect water, usually but not always upstream of dams, and the dredging of soil or above-ground material occurs, with the best of intentions. The ecological disasters are from ignorance.

Water is slowed by an impediment. Sediment carried from the fields (the good top soil) in the flowing water is dropped, so accumulates in impoundments. Therefore these store less water, and eventually are excavated again. Such dredging should be little and often, never allowing sediment to smother even short plants and never breaking the hard bed in which propagules are stored and which forms a satisfactory base; unless the excavating is done in sections over several years, and large lengths of bed

Fig. 10.6
Fire damage.



are never dredged in a single year. These precautions

- (a) maintain populations;
- (b) allow biota to colonise newly developed areas from uncleared ones;
- (c) maintain good habitat.

11. Fire (Fig. 10.6)

Fire kills not only the existing vegetation, but if fierce and heating around soil level, it also kills the invertebrates and smaller animals and the seeds and other plant propagules around soil level which, after a "light" high-level fire, can re-populate the site.

12. Recreation

While recreation is a proper activity, learning about and enjoying the countryside being an important part of life, doing it in such a way as to — quite unintentionally — destroy the very countryside people come to enjoy, is wrong!

*Where we have been, no one can find,
For never a trace do we leave behind.*

This children's rhyme sums up the proper attitude to recreation: if anyone coming after can see you have been there, whether by litter left, plants broken, soil disturbed, soil worn, rock marked, stones displaced (for snail-picking or filling puddles) or anything else — *this is wrong*. (The design and changes needed to encourage proper recreation and stop what can only be



Fig. 10.7
Off-roading damage to
river bed.

termed vandalism, are discussed in later chapters.)

Few people realise that what one person coming once a year can safely do, a thousand each weekend cannot. Trampling on a few flowers, breaking some twigs, pushing through trees, kicking aside some stones in the way: over the next 364 days nature more than repairs this. But in, say a six month period, that is, 26 weekends, each with 1,000 visitors and therefore a total of 26,000 "visitor events" and assuming that each of these "events" damages 6 flowers and 10 twigs, (a very small estimate), 156,000 flowers and 260,000 twigs would be adversely affected, if not destroyed. Then add perhaps 390,000 stones moved (with all the invertebrate and microbial life disrupted). That means that this particular site of beauty is each year diminished, degraded in beauty and natural value.

Everyone needs to learn this particular multiplication table!

13. Walking and picnicking

Visitors should note the principles above. Keep to paths and picnic areas where these exist. Many more should be made, but only by those expert in conservation principles.

14. Leaving litter

No extra comment needed.

15. Motor vehicles, off-roading. (Fig. 10.7)

These are extremely damaging, and off-roading should be forbidden, except perhaps in a single area marked off to be destroyed by this activity.

Perhaps one already destroyed, for instance a spent tip or quarry? Otherwise, motor vehicles (including motor cycles) should keep to surfaced roads. More than enough of these already deface the widien (e.g. at Mistra). Passage is lawful if the roads are wide enough and are public property.

16. Riding (horses, pedal bicycles etc)

Here again one horse once a year is quite harmless. But having large heavy animals thumping around and narrow (therefore heavy) bicycle wheels turning in large numbers, disrupting the vegetation and soil is another matter. They should keep to specified trails and firmed tracks (of which, again, there are already over-many) where the riders can enjoy country views but the hooves and wheels do no damage. (See previous paragraph for access).

17. Canoeing

This is limited to the lower Ghasel (Rihana) in wet years. If the canoes touch banks only where these are re-inforced near bridges, do not disturb the water enough to disrupt the soil of the bed below, and spectators stay on the roads, that is fine. Otherwise, canoes damage banks and spectators damage the riverside.

18. Climbing and abseiling

Once more, it is numbers that matter. Anyone on a cliff face will

- (a) kick or move plants in cracks;
- (b) scrape off lichens from rock;
- (c) chip or wear off the rock itself.

Plants in cracks can be replaced in anything from about 2 to about 200 years, depending on how much soil was removed and the species and size of the plant. Lichens can re-grow in 20-100 years. Rock can **never** be replaced or re-grow.

Those enjoying this active countryside pleasure rarely think of this! Anyone wanting to check on cumulative damage may visit the abseiling areas near Ghar Lapsi. These activities should be restricted to

- (a) bridges (of non-historic importance), man-made and man-replaceable;
- (b) buildings (of non-historic importance), again man-made and man replaceable;
- (c) maybe one or two cliff areas designated for destruction by this activity
- (d) any safe walls in disused quarries. These would make excellent abseiling and climbing places.

11

THE CONSEQUENCES OF DELIBERATE DAMAGE

These overlap with the activities in Chapter 10. The division is arbitrary, but people doing the activities in this chapter know or should know that they are destroying natural or historic heritage, or creating hazards.

1. Dumping of rubbish and rubble.

For the physical and chemical results, see Chapter 7. They include smothering plants and animals, flood hazard, and pollution (and see next paragraph below).

2. Blocking up historical features by dumping, (Fig. 11.1).

By the time this book is read, Ghar Hanzir, a unique type of swallow-hole entrance, may be lost under rubble. St Catherine's chapel in Wied il-Ghasel is at risk. How much has already gone, or will soon be gone?



Fig. 11.1
Rubble near, and about to cover important entrance (swallow-hole) to underground river channel, possibly leading to Marsa. Ghar Hanzir, Wied Qirda, Kbir.

The Consequences of Deliberate Damage

Fig. 11.2
Channels lined (also see Fig. 8.6).

(a) Right. Wied Xkora, Kbir
(b) Below. Qormi (Haslam 1991)



3. Obstructing water flow in valleys.

By gates, netting, rubble etc. causing flood hazards, see Chapter 8.

4. Pollution.

From effluents, urban and rural run-off, overloaded or faulty sewers and rubbish, see Chapter 7. This is damaging to water resources as well as watercourses (and see 'Drainage' below). Polluted water means polluted rivers and polluted aquifer, so polluted spring and borehole water.

5. Putting streams underground.

Very rarely this is necessary in towns, but it is usually done because it requires no thought, while making an urban stream an ornament and delight to the neighbourhood does require thought. Open water purifies its pollution to a considerable extent also, while underground water hardly cleans itself at all. Underground channels are also more prone to blockages.

6. Lining the bed or valley floor with concrete, asphalt, stones, etc. (Fig. 11.2). Lining may be done over part or all of the valley floor, and it varies from being very satisfactory to being disastrous. The Chadwick Lakes road is excellent. It takes up only a small part of the wied width, it is too narrow to permit excessive traffic noise, pollution or speed, it is unobtrusive in



Fig. 11.3
Removing historic features, early Knights' water channel and old bridge, Wied Girgenti.

(a) 1986.



(b) 1992

colour and it allows walkers, riders and drivers to enjoy the beauty here without leaving the tarmac and causing damage.

Destroying the Sewda in Qormi is perhaps the most disastrous and totally unnecessary example. (See 'Putting Streams underground' above, it could have been made the pride and delight of the town.) Erosion may yet prove easy.

Lining for excessive storm flows is sometimes justifiable, but usually reflects a lack of wish to solve the problem in a better way (e.g. altering flow capacity upstream, creating an ornament). Narrowing wieden with rubble to widen or create roads is shocking — and hazardous (as in Qormi by the

Cemetery). Using now-dried (or drying) tributaries as farm access tracks is suitable, concreting or asphaltting them, is not. Having a stream channel beside a road is fully acceptable (if properly managed).

There are already too many damaging roads within the wieden. Many wieden should, for heritage, natural history, beauty etc, be without any.

The government grant for concreting tracks in the countryside should best be replaced by one for repairing damaged or worn out tracks utilizing spalls and sand, rolled firmly and in a professional way.

7. Removing features of historic importance (Fig. 11.3).

An excellent example here is the Knights' water channel collecting water from the bed of the Girgenti river. Fig. 11.3 shows the loss of this unique piece of Malta's heritage and of a valuable, though fortunately not unique, old bridge. Such wilful destruction should be forbidden by an enforceable law. Compensation (see Chapter 15) should be paid to farmers to keep heritage channels in place, rather than selling them to go to places where they are not heritage.

8. Quarrying (Fig. 11.4)

Quarrying should be prohibited from:

1. removing or damaging Areas of Outstanding Natural Beauty, such as is happening in the Ghasel, where a spectacular and unique gorge wall is being taken away. Quarry owners should be made to maintain such landscape features.
2. removing or damaging the stream bed as in the Sewda and Ghasel. The bed is needed partly for reasons of conservation, heritage and beauty, and partly to prevent so much polluted wieden water percolating straight down, uncleaned, into the aquifer (as on the Sewda). Surface water should (mostly) stay in the rivers.
3. dumping rubble where it is unsightly or covers over historic heritage sites such as swallow-holes or old water channels or any part of wieden (see the Ghasel and the Sewda! It is found down the slope, as mounds, and worse). Some rare species, e.g. *Ophrys oxyrhynchos*, have already been totally lost from Malta by dumping (Schembri and Lanfranco 1993).
4. causing vibrations that damage animals, as is now happening on the Sewda. Farmers can, with expense, move their farms; wild animals cannot move away. But why should even farmers be expected to move?



Fig. 11.4
Quarry destroying
landscape, Ghasel.



Fig. 11.5
Covering valley floor
with rubble.

5. causing vibrations that can damage historic heritage, as has happened in the cave of St Paul the Hermit on the Ghasel and to Mnajdra temples allegedly from nearby quarry blasting operations.
6. permitting quarry dust to leave the quarry site or batching plant and pollute the wied, as now in the Ghasel and at Lija.

The present quarrying regulations (Development Permits from the Planning Authority under the 1992 Development Planning Act) are clearly unable to prevent such damage, and enforceable changes are needed.

9. Snail collecting.

Collecting snails for eating is a proper and traditional country activity, but, like many, has got completely out of hand. When a farmer's family collected snails for their own use on their own land, they did not over-harvest. They wanted snails again next year, on their land, the land they could use, so they ensured enough remained to continue the population. Secondly, they did not damage walls, stone piles etc, while collecting, because they knew they themselves would have to repair all the damage they caused. Snails, though, do move along the road.

Neither constraint now applies. The snails are collected to the detriment of their populations, and to the damage of dry walls, valley floors etc. It is, regrettably, time for legal action.

10. Frog, reptile etc. collecting.

Unlike snails, these are not harvested. Collecting is done just for fun. However, up to half a century ago there was both sufficient habitat, and sufficiently few people collecting, for these to cause no adverse effects. (It is difficult now to remember, but most Maltese were urban folk, and even in the 1960s, hardly ever left built-up areas except for e.g. the coast road and Buskett.)

Under the 1993 Act, all collecting is prohibited. Few people, though, even know of this law, let alone abide by it. Children must be taught to observe tadpoles in the wieden - and return next week and the week after if they wish - and **not** to collect them or take them away. NB: Where this change of attitude has taken place, children are quite as excited at watching animals in the wild, as their predecessors were at having a jar of (usually dying) tadpoles in the house.

11. Grazing.

Grazing by goats and sheep is another proper countryside use that, in places, is out of hand. It is now possible to feed livestock without grazing wild land, as the amount of wild land is in short supply. Grazing is particularly effective in stopping the growth of woody plants. The tips of seedlings and saplings are nice to eat, and, with their tips removed, many die.

Grazing in Malta has always been liable to excesses. Too much vegetation is removed, the grazing is non-sustainable, and the land becomes barren, fit for no farming use, and of poor conservation quality also. Goats are more damaging than sheep, as sheep leave more plant.

Goats easily eat up vegetation and climb steep as well as gentle valley sides.

The effect of "traditional" grazing is seen on gorges where the steepest cliffs are inaccessible even to goats. Such sites have taller and more diverse plants than the more favourable habitats with less slope and exposure, and more soil. The effect of modern over-grazing comes where domestic livestock graze and visitors beat down vegetation with feet, horses, cars etc. The community cannot sustain both, and each year the bare soil increases and the tall and woody plants decrease.

Here a policy is needed to balance the conflicting needs and produce a sustainable resource.

12. Killing aquatic and wied birds by hunting (shooting) or trapping.

Apart from (farmers') pigeons, sparrows and birds in large highly-guarded reserves like San Anton Gardens, any bird in Malta is expected to be killed in the open season, and may well be, in the close season. Theoretically no hunting, even in the open season, is allowed in nature reserves, gardens, the airport, cemeteries, close to buildings or asphalted roads, but even for human safety it is unwise to assume this will be so. There will be no aquatic and wied bird communities as long as people prefer killing to watching. (see Frog, Reptile etc. collecting above).

13. Unsatisfactory tree planting for hunting, (Fig. 11.6).

Trees are environmentally good, even if planted to attract birds to be killed or trapped. However, most hunters, unfortunately, usually plant exotic eucalypts because they grow fast and are evergreen, which should never be put outside towns. (They are non-native, damage the "Sense of Place", damage the "Sense of Malta" and have a poor invertebrate fauna.) Birds would be more attracted to native trees, where they could find more food.

14. Destroying trees for hunting, (Fig. 11.7).

Trappers and hunters cut down trees inside groves so they can put up huts, or sit in greater comfort. They also cut off the tops of trees to prevent growth over 1.5 – 2 m high, to open up the trapping area or to have a good field of vision. Trappers do more damage per head as they clear the land and keep trees cut short as shrubs. They also occupy more space. Both are deplorable. Cutting may destroy the only Maltese examples of groves of some trees.

Fig. 11.6
Planting of unsatisfactory exotic trees (eucalypts) by hunters.



Fig. 11.7
Destruction of trees by trappers.



15. Other inappropriate tree planting.

Tree planting, as well as being of unsuitable species, may be of foreign or non-local genetic strains of native species, so contaminating the local gene pool.

It may also be done where the trees will cause unstable banks, flood hazard, or the loss (by shading) of unique plant or animal communities.

16. The Valleys Good Luck or Bounty Scheme, Risq il-Widien, and similar schemes of valley disruption.

This specific scheme, in the early 1980s (following the 1979 floods),



Fig. 11.8
Loss of "Sense of Place"
with excessive human
impact.

(a) Gholleq.



(b) Wied San Niklaw.

replaced and built new dams, which was good for farm water supplies except that they were not well constructed, since some are already breaking. Regrettably with no ecological advice, it also widened and cleared watercourses, planted exotic trees, put in more roads (thinking these increase water resources), and tried to provide recreational facilities. Much of this is also recommended in the Structure Plan, again without requiring advice from the Water Services Corporation or ecological experts.

The aims are good, the results ghastly (for instance *Cyperus distachyos*, *Iris pseudacorus*, *Juncus capitatus* and *Ophrys apifera* have become

Fig. 11.8 (cont.)

(c) Wied il-Baqquja,
Kbir.



extinct through disturbance in some areas (Schembri and Lanfranco 1993). This is an example of the oft-repeated statement that in the natural world results are governed by actions, not by intentions. With proper design all these aims could have been achieved in suitable wieden, to the satisfaction of all concerned.

17. Drainage.

The damage done by this is mostly completed (Salina, Marsa etc,) but some people still think that water is somehow almost evil and must be got rid of at once. Water is necessary! And in places (not indeed all places) it best serves water resources as well as conservation to have waterlogged and flooded land.

18. Biocide spills.

Carelessness with biocides can be damaging, as in Bahrija in 1984, where much of the valley floor vegetation was killed or stunted (Schembri and Lanfranco 1993).

19. Confusing urban and rural situations.

The countryside has natural beauty. Towns are ornamented by the finest human skills devised, by beautified rivers as well as by beautiful palaces. Many ugly and inappropriate situations are due to confusing town and country, by putting artificial ornaments — or exotic trees — in a rural valley, and by failing to beautify town rivers (but instead putting them

underground or making them really ugly).

It should here be noted too that "one man's meat is another man's poison". Maintaining, restoring and perhaps enhancing the traditional features of a rural wied is the correct thing to do, even if the Project Leader thinks acacias and some good straight walls would be nicer. No. Given the status of Malta, each wied may well have features not just unique to Malta, but unique world-wide. Taste is more relevant in towns, and since there is no Maltese tradition of beautified and beautiful urban rivers, ideas may well be brought in from abroad, and modified for the Maltese culture.

20. Losing Sense of Place (Fig. 11.8).

The Maltese Islands must be nearly or quite unique in having so much diversity and variation in locality. Each place in Malta is different, recognisably so. Maintaining the "Sense of Place" is therefore essential in maintaining cultural heritage.

This is being lost in the widien, through lining (concreting, asphaltting etc), modern uniform walling, lines of eucalypts, infilling with rubble, dredging and others of the regrettable activities described in Chapters 10 and 11. All that is needed to prevent this is thought and care.

12

THE MAIN WIDIEN: THE GHASEL, KBIR AND SEWDA RIVER SYSTEMS

These three systems show much variation in landscape, water regime, vegetation and cultural artefacts.

The River Ghasel System (Figs. 12.1–12.3, 2.1, 2.5 and 4.1)

The River Ghasel system perhaps is the best known. Most people know or know of Chadwick Lakes, for instance. It ought to be even better known. Scenically it is both delightful and varied, culturally it is exceptionally rich, and the river vegetation and farming are by no means to be despised. Its sources are the Liemu to the east, probably named after a Carmelite superior (Fr. Guliermu Cassar c.1441) rather than "reproach", the Busbies to the south, which undoubtedly still bears fennel (*Foeniculum vulgare*). Wied vegetation, though, must have changed much if this stream could be singled out as especially bearing busbies/fennel! Fennel is now, perhaps, the most abundant of summer river species. The third source is the Ghemieri to the west, which contributes much less water.

The Liemu is best regarded as the Upper Ghasel, as it now carries the most water, even though the lower Busbies is larger and with, locally, even more water. The Liemu rises as a depression in dry limestone, as is common, but soon acquires — in winter — a good supply of clear water, which runs right along the length to the Busbies confluence. The water rises mostly along the gnien line which surrounds its Blue Clay, a good farming basin. Although the water is beautifully clear, upstream the amount of foam regrettably shows pollution by detergents — and detergents rarely enter water alone, they are accompanied by other household liquid waste, usually including sewage. This "diagnosis" of pollution is confirmed by the sparse and semi-tolerant river plants, such as *Apium nodiflorum* (fool's water cress), mainly, and by farm pollutants (e.g. agrochemicals).



Fig. 12.1
Upper River Ghasel,
Wied il-Liemu.

(a) With road beside and nice farm bridge; flowing water (straightened near, winding with landscape far; channel dug out; part walled).



(b) Channel with good natural bends; over-shadowing trees in middle distance; of dug outline but fair vegetation interest (*Festuca arundinacea* abundant, *Chrysanthemum coronarium* etc. up the bank).

The Figures in Chapters 12 and 13 are from upstream to downstream, starting with the main river line, continuing with the tributaries, in order of their confluences. The photographs were taken at various seasons and in various years. For all, note general riverscape (gorge, plain, water presence etc); farming and other land use in valley; distribution of houses; of trees, orchards, vines and other woody plants; the spring-line (gnien area) if present; the structure (type, diversity, texture etc.) of bank and bed; the vegetation of bank and bed; and other recent and ancient cultural structures (roads, walls, dams, bridges, chapels etc). Students and school pupils should list all, including sizes of bed, bank and valley.

The Liemu has many delightful features. Water runs through good old stone walls, and has a diversion channel. Lower, it winds along the valley base in as near a natural pattern as occurs in Malta. Nice flood overflows come from run-off, though these, however nice to watch, cause loss of top soil, and erosion: control should instead be applied. Water sources are available for irrigation, and the farming is good. The "Sense of Place" is

Fig. 12.1 (cont.)

(c) Looking upstream from confluence with Wied il-Busbies; walled; at base of valley; reasonably diverse vegetation.



strong, the area retaining a nineteenth-century pattern, with quality suited to the late-twentieth century: unusual and highly appropriate. Fruit trees are grown, and trees also grow along the gnien line. A reservoir bears goldfish. Goldfish combine ornament with (if their feeding is correct) removal of organic waste, and are pollution-testers. If the fish die, the water has been polluted (probably by biocides) and is therefore unfit for use. As

well as for this strictly modern purpose, the fish may have had historical purpose. Medieval holy wells further north typically contained a trout or two, these being themselves echoes of the "magic trout" found in legends of pre-Christian holy wells.

Ancient indeed are two pack-horse bridges (Fig. 6.7) both on routes from look-out posts in the south to Mdina, so news of raiders could be swiftly brought to the garrison. These two have — mercifully — not been destroyed as old junk, but have been repaired and replaced at different times, each in the style of those times. Though we could have done without the modern cemented stone! The old style should have been continued. As usual, a modern and very much lower bridge is beside both, originally a ford for carts, built and asphalted etc. for cars. (It is worth looking, here, to see the former higher river level.) Modern concrete slabs form field bridge access across the stream.

The channel itself widens from 1–2 m with upstream water, to 3–5 m. It is dug out (see the bank types and Fig. 1.3) as expected in good farming land, so narrower and with steeper banks than it would naturally be. The



Fig. 12.2
Middle and lower
River Ghasel, Widien
Qlejgha, Speranza and
Ghasel (see caption Fig.
12.1).

(a) Impoundment with
water in August (local
springs) with shading
(cooling) trees beside;
dominant duckweed
(*Lemna minor*); with
Alisma plantago-
aquatica patches etc.



(b) River bed mostly
uneven, with a river-
worn surface of
Globigerina limestone;
present road and old
road to left, present
track to right, with dif-
ferent construction;
walls of different types.

proper amount of *Arundo donax* occurs, sufficient for farm use without clogging the stream flow. *Scirpoides holoschoenus* is prominent by the downstream confluence, where this stream, thanks to digging and other management, appears smaller than the Busbies.

The Busbies is in quite a different riverscape, also with charm. It rises on a dip in karstland, gradually becoming more of a channel, being a few meters wide with plenty of shading trees giving a good focus to the view. Old irrigation channels and wells will, it is hoped, be preserved, as also the nature of this dry channel: large gnien outcrops are absent round the top, in contrast to the Liemu. Tributaries enter, one bearing by it the "Wied il-

Fig. 12.2 (cont.)

(c) Poplars (*Populus alba*) planted in medium ground level in river bed, trunks not a flood hazard; *Rumex conglomeratus*, small in this (in 1987) near clean habitat and other damp and land species on floor.



(d) Walled river; wall partly fallen; footpath at side of bed; bed with variations of ground level and vegetation.



Busbies Spring": map-makers and spring-owners clearly differ on which is the main river channel. Maps show it as the western tributary. The spring, and the logic of having a straight stream, indicate the southern one. In winter weather, several running streams enter, bringing turbid (soil and agrochemical-polluted) water. Aquatic and marsh plants are few. At one confluence the old channel is now a row of fields (between walls), running water has been diverted to the road, and then, instead of reaching the old confluence, a pile of soil (!) turns it towards the main stream. A pleasing old arch-bridge gives access to fields further down. Near the confluence there



Fig. 12.2 (cont.)

(e) Bed width varying with rock outcrops at side; bed mostly earthen, woody growth at base of "scarp", considerable diversity of bank, little of bed; (*Foeniculum vulgare*, *Dittichia viscosa*, grasses etc).



(f) Start of Lower Coralline gorge; sides rock or wall of terrace (or, left middle, both); dam partly silted upstream; flow path below it bare (i.e. enough flow to scour away land plants, too dry for water or marsh plants); been ornamented with exotics, e.g. *Cycas revoluta*.

are striking run-off pipes bringing dirty road water direct into the stream bed, which by here, typically receive winter water (catchment large). The plateau is water-bearing, with boreholes, and run-off: unlike the deep gnien embayments of the Liemu.

The third upper stream, the Ghemieri, with its own tributary, (the Ghomor), is very different again, the slope and "Sense of Place" having a feel of England — if the limestone caps to the hills, the size of field and type of crop are omitted! Here, streams rise at the base of wide vales, which have large, not terraced fields. There is an interesting relic upstream.

Fig. 12.2 (cont.)



(g) Even drier (not just because recorded in summer); steep rocky wall with trees at base on right; collapsed slope on left; bed with stones (with rain-eroded surface) from above, local soil and stones; caves above; (*Dittichia viscosa* etc, on bed, *Foeniculum vulgare*, fennel, more on higher level).

(h) To show destruction of the gorge wall by a quarry, and a fall of rubble; decayed Victoria Lines to left.



The Ghemieri and Ghomor bear trickles of water downstream in winter, quite different to the upstream rising and near-continuous flow of the Liemu! The open landscape means the small channels, hardly more than dug ditches, can be traced for long distances, the downstream size increase being little. Near the base the channels become larger and bear aquatics such as *Scirpoides holoschoenus*. It is interesting that here and on the Busbies, water plants are common in the area of winter flow, while in the Liemu, they are only well downstream of its start (management? pollution?).

The river channel much increases in size. Quite suddenly the channel



Fig. 12.2 (cont.)

(i) In Burmarrad plain, former channel walled, but converted to farmland by bringing in soil (see Fig. 1.3 for present flow path).



(j) Near mouth, very pretty with *Acacia cyanophylla*, acacia and *Phoenix dactylifera*, date palm, both of which should be replaced (on death) by native trees; *Phragmites australis* (reed) to right, (because of the slightly salty water); various aquatic, marsh and land species on bed. This degree of shading is wanted intermittently along each river.

width is 8 m and more, the bed sunk several meters below the level of the surrounding land, part being strongly walled, with large buttresses (downstream on the Ghemieri) against heavy eroding flow even being found near Fiddien bridge (now decaying: of historic importance as indicating such flows when they were built). The main channel is now Wied il-Qlejgha, or the Middle (rather than Upper) Ghasel. This deserves study and thought. How much water can flow in these rivers if none was taken for farm and domestic supply? How much from the (then) large springs? What fierce flow did the earlier Maltese have to expect, and by walling, prevent from eroding land and soil? There are dredged impoundments — dredged shockingly for

Fig. 12.3.
Tributaries of River Ghasel (see caption Fig. 12.1).

(a) Upper Wied il-Busbies, North branch. The *Arundo donax* band marks the river, trees are on the bank upstream.



(b) Lower Wied il-Busbies. The poplars (*Populus alba*) were planted well before the road was enlarged; river walled; little bed diversity (except with shade); mud; bed bare from scour, partly straightened.



conservation, and it takes only minor care to dredge for both water and conservation. The effect can be seen by examining a recently-dredged impoundment, which is bare, and a long-dredged one, which typically has *Alisma plantago-aquatica*, (water plantain), all over it with little else. Then in wet weather, the lower level and undredged part of the Chadwick Lakes area should be looked at, and the number of different kinds of plant in and near the water, counted. Eight to twelve are probable in a short distance. What a difference! Animals respond similarly, but are less easy to count. They also tend to recolonise impoundments rather quicker. Tadpoles, frogs, water boatmen, dragonfly larvae, water snails, etc. are



Fig. 12.3 (cont.)

(c) Ghemieri Valley. Muddy water below; with *Scirpoides holoschoenus* at side; walled; adequate conservation value; main stream curves round to its source, centre far; tributaries come in from both sides.



(d) Wied l-Armla. Walled; developed into a farm track.

found. Summer vegetation is monotonous, more *Arundo* above, much fennel, tall (e.g. *Festuca arundinacea*) and short grasses, and on rocky places much sticky samphire (*Dittichia viscosa*). This is typical all the way along in drier parts, with only small variations. The really interesting vegetation is that of winter, in the non-impounded part of the Chadwick Lakes, with variation of community with level, duration of flooding and bed texture as well as season, e.g. wetter to damp: *Alisma plantago-aquatica*, *Eleocharis palustris*, *Rumex conglomeratus*, *Veronica anagallis-aquatica*, etc; *Alisma plantago-aquatica*, *Oenanthe globulosa*, *Rumex conglomeratus*, etc; *Carex* spp. *Ranunculus muricatus*, *Veronica anagallis-*

Fig. 12.3 (cont.)

(e) Upper Wied il-Ghajn Rihana. Walled, developed into a little-used farm track, partly straightened.

(f) Below. Lower Wied il-Ghajn Rihana, 1987. Buffer strip to left (poor one on right); good mildly polluted river vegetation (including *Typha domingensis*, *Ranunculus trichophyllus*, *Cyperus longus*, *Veronica anagallis-aquatica* and Blanket weed); species diversity moderate (good for Maltese rivers); structural diversity poor. Seriously deteriorated by 1997.



aquatica etc; and *Mentha pulegium*, *Potentilla reptans* etc; with, into drier ground, *Galactites tomentosa*, crucifers, grasses and *Dittichia viscosa*. (see Chapter 3 for species lists in general). *Aster squamatus* is common in drier impoundments, particularly showing in summer. This, perhaps individually the most valuable stretch of river in Malta, is the one badly damaged by recent pollution (see Chapter 7). *Rumex conglomeratus* is spreading (and larger), and the more sensitive species are (in 1997) in rapid decline.

Larger animals occur in the



Fig. 12.3 (cont.)

(g) Wied il-Arkata (tributary of Wied il-Ghajn Rihana). Walled farm track with small clear (spring water) stream at side, with too much algae to be clean. (*Festuca arundinacea* etc; *Oxalis pes-caprae* etc. on higher ground.)

valley too, of course: various birds (particularly in the migration season, and if not killed at once) and rabbits, hedgehogs, weasels, etc. and sheep, goats and other livestock graze. Their grazing is damaging because, together with the disturbance, it prevents vegetation recovery (see Chapters 4, 11 and 16).

The recent rehabilitation works in this area removed much of the accumulated silt, and exposed a lost stoned Way below, once used for transport along the river bed.

There is a sharp change in riverscape from the Upper to the Middle Ghasel both natural (large channel, flatter ground) and man-made (all else!). "Sense of Place" is again strong. The dams first put up by Mr. O. Chadwick in the 1890s are well-built, strong and effective. He, presumably, would never have tolerated the falling retaining walls, worse, perhaps, in the Qlejgha than in any wied in Malta. The dams are often sited both at nick-points in the valley profile, and where spring-water wells up in the impoundment behind, giving maximum irrigation water. It is the upstream "lake" which, as described in Chapter 2, originally had much abstraction for supply (a 22 cm pipe-flow all summer). The springs were, therefore, both perennial and strong.

Deeper impoundments, too deep (or too new) for water plantain, may bear duckweed (*Lemna minor* agg.) Currently, water is abundant (in suitable weather) in the impoundments of the Qlejgha, and just into the

Fig. 12.3 (cont.)

(h) Wied Qannotta. Wooded gorge (used by hunters) with spring line; variation in bank and bed, good for vegetation — for part of the length).



(i) Mid-Wied Qannotta. Gorge opening into a wide terraced (farmed) valley; still pleasing.



next section of the Middle Ghasel, the Wied l-Isperanza. Water between impoundments (except with severe storms) is mostly in the Chadwick Lakes zone. Fig. 2.4 shows the downstream losses of waters, well exemplified here, though not with strong mid-river springs! Only recently the Chadwick Lakes area could regularly become bank-full (picture by Gianni, 1882) and river-worn stone is common down into the lower Ghasel. The loss to Malta has been great, too great for the current benefits (it should have been re-done, perhaps about 1910). To "sell the family silver" - (destroy the water table) for short-term gain is never wise.

Much of Chadwick Lakes has been beautified by white poplars (*Populus*

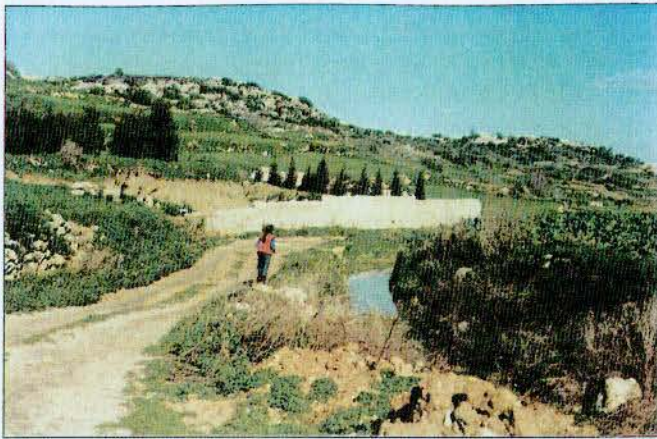


Fig. 12.3 (cont.)

(j) Lower Wied Qannotta. Landscape more open, though with rocky outcrops above; local spring, with reservoir on left (behind wall) and water in river; river narrowed by road and field, dug-type edges, over-smooth and uniform.



(k) Lower Wied Qannotta. Almost in plain; a straightened dug small grassy depression (most flow lost upstream). Originally the river would have entered the wetland here.

alba), and part resembles a small wood and is very pleasing. The trees now grow in the channel, but their tall, thin trunks are no flood hazard. Lower, exotic trees have been planted. Pleasing, but wrong, and they are best replaced by native species as they die. *Arundo donax* grow especially in the disturbed upstream section, where it can overgrow and be a flood hazard. Except for Chadwick lakes — and even their neglect and damage are manifest — the wied is suffering greatly from a mixture of lack of maintenance, and unsuitable management. Over-use of the Wied il-Ghasel near Mosta and the upper Qlejgha has had deplorable results. The lack of

Fig. 12.4.
River Kbir (see caption Fig. 12.1).

(a) Upper Wied l-Isqof, minor road and narrowed watercourse in walled channel; wall partly broken; stream bank man-made, smooth and uniform; (*Dittichia viscosa*, *Foeniculum vulgare*, grasses etc).



(b) Lower Wied l-Isqof. *Arundo donax* dominates in channel beside minor road.



proper dredging within the impoundments (both dredging done properly and the removal of accumulated silt) is equally deplorable, and the wied, if not attended to, is heading towards the horrors of some other parts of the Kbir. The wrong sort of attention, though, would bring the horrors sooner: **no disturbance and no dredging of hard beds, please!**

The bridges, like the dams, are of much interest. They include new flyovers and more solid structures, ones built for farm access by carts and expanded (with better turning zones, and tarmac) for cars, and those still just for farm access. Studies of all, with dates, would make interesting



Fig. 12.4 (cont.)

(c) Wied Baqqija. Turbid water in impoundment; flat uniform bed, mostly soil; man-made banks with some variety (grasses, *Arundo donax* etc); access for vehicles to impoundment; walls various.



(d) Upper Wied il-Luq, in Buskett Gardens. (e) Lower Wied Qannotta. Almost in plain; a straightened dug small grassy depression (most flow lost upstream). Ornamental, with flat shaded leaf-strewn earthen bed; channel gathering water at side (showing there was much more water here in the seventeenth century); ornamental walled sides with ivy (*Hedera helix*) on right.

school projects! Why was each bridge sited where it is? There is an undue frequency of bridges here: combining old farm access, old military and other roads, and modern highways.

The farmland around is mostly flat on the *Globigerina* limestone and of good quality.

Let's go to Chadwick Lakes (Haslam 1998) can be used here too, as a guide to field study.

Towards and in the Speranza and Wied il-Ghasel proper the watercourse beds become drier, with little aquatic vegetation outside — or even

Fig. 12.4 (cont.)

(e) Lower Wied il-Luq, with Girgenti confluence far, marked by dominant *Arundo donax*. River excavated for impoundments, but better done than usual, with reasonable variety and vegetation; minor road constructed beside channel; giving man-made banks on both sides of river; but with some structural and vegetation diversity (slopes the same, vegetation and ages different on the two sides); Blanket weed in water indicates some pollution.



(f) Upper Wied il-Girgenti. Head of valley (beyond was a delta-shaped, farmed depression, now a quarry); slope dropping steeply, with decayed walls etc; spring line used to be well-marked at the edge of the scarp; some woody plants.



within-impoundments. Nick-point dams still occur, and receive storm water. The old smooth river-worn watercourse is often prominent (away from impoundments that destroy!) with lichenized, rain-worn rocks clearly differentiated above them and cart ruts embedded in the rock in places. The re-discovered stoned way further up (see above) must have come as a relief!



Fig. 12.4 (cont.)

(g) Lower Wied il-Girgenti. Stream emerges from gorge still with some springs, into good farmland with wide fields on lesser slopes; pond dug out, water turbid and polluted; much *Arundo donax*, which dominates the banks and the drier (higher) parts of the bed.



(h) Wied ix-Xaghri tributary. Dominated by *Arundo donax*; (drier than River Girgenti); minor road parallel and narrow.

In the Speranza is a deep swallow-hole, a solution-hollow often found in limestone, where water eats away (dissolves) the solid rock. Once one of these has opened, much low-flow, and some storm-flow water goes down it instead of continuing along the river bed. Its fate depends on the below-ground pattern. The water may replenish the aquifer (deplorable when polluted with road run-off etc!) or find a downstream way and emerge either further along the river bed or in the sea.

The bed is often 15 m or more wide. Approaching Mosta, the Ghasel cuts

Fig. 12.4 (cont.)

(i) Wied il-Hesri. General mess! rubble crossing; with rubbish; *Arundo donax* on bank of impoundment beyond.



(j) Wied il-Qirda, main gorge. Spectacular rock faces with woody plants in pockets of soil (rocky and scarp-base spring-line); structural diversity of bed and bank; vehicle damage in bed.



through the Lower Coralline gorge, gradually deepening. At its deepest, the base has a wide, farmed, floor with the watercourse to one side. In this really spectacular and unique gorge, is the wonderful cave of the chapel of St Paul the Hermit, the good one of Our Lady of Good Hope, various interesting catacombs and St Catherine's Chapel. Formerly there was excellent woody and herb vegetation, animals and beauty. Now, it bears the quarry, which disfigures the landscape, has removed gorge wall, removed part of the Victoria Lines, made cave rock fall with its detonations,



Fig. 12.4 (cont.)

(k) Upper Wied il-Kbir. General mess; the channel is worn into a track; access road above (fennel, *Foeniculum vulgare*, abundant).



(l) Lower Wied il-Kbir. Grazed herbaceous vegetation over uniform bed and bank; diversity low.

and is smothering slope and bed with its debris. In the impoundments below, the water is badly turbid (though not badly poisonous) from the dust, and the habitat is damaged. *Rumex conglomeratus* can grow. So, regrettably, does pollution-favoured Blanket weed (algae). The water looks like the awful quarry rivers of parts of Italy and Sicily.

At this point the Ghasel enters its downstream section, still named the Wied il-Ghasel, as it passes into the alluvial Salina/Burmarrad plain, now well-drained and bearing crops, formerly a marsh (still earlier, the water and the port came far inland). Little water now enters, most of the run-off rain-water has been caught by the upstream dams, and in fact below the

Fig. 12.4 (cont.)

(m) Upper Wied ic-Cawlsli. Bed about 10 m wide, uniform, with trees planted at side: on base, slope or top of bank (this would be good if all were native trees).



(n) Lower Wied ic-Cawlsli. Very wide grassy bed, bounded on left by wall and trees beyond; on right by trees. This is an extension of the former Marsa marsh (on the estuary of the Kbir and Sewda rivers).



dam opposite Burmarrad the very watercourse has been lost. It has been infilled with soil brought from outside the area (though its boundary walls, and some of the causeways formerly used to cross the marsh are still visible), and any water passing that dam finds its own course over fields.

Finally, at the mouth, the channel re-appears, and a good estuarine habitat exists. Just inland the channel is very pretty, ornamented with acacias and palms (with *Phragmites australis* and other appropriate species as well). This, though, is **not** the Kennedy Grove, which is, quite correctly, ornamental. It is the proper river channel of the Ghasel, and no exotic trees should be allowed. They need to be replaced (on death).



Fig. 12.4 (cont.)

(o) Upper Wied ix-Xkora. A narrow, disturbed bed with a widened track beside; walled (*Foeniculum vulgare* etc).



(p) Lower Wied ix-Xkora. Completely lined, even less conservation value than (o).

The larger tributaries entering the Ghasel, considered from upstream to downstream, begin with the lane coming steeply down the hill from Rabat (Chadwick Lakes). This is a "water lane", with water on the road as well as in the side ditch, in storms. The recent pollution come in around here. The Armla comes in from the west, and, due to dryness and a steep enough slope there for soil erosion, is now a farm track on bare rock, not immediately obvious as a tributary at all.

The Wied Ghajn Rihana, and its smaller tributary, the Wied Arkata, almost form a river system themselves. They used to have the best aquatic vegetation, and are pretty and charming rivers. In land form, such as

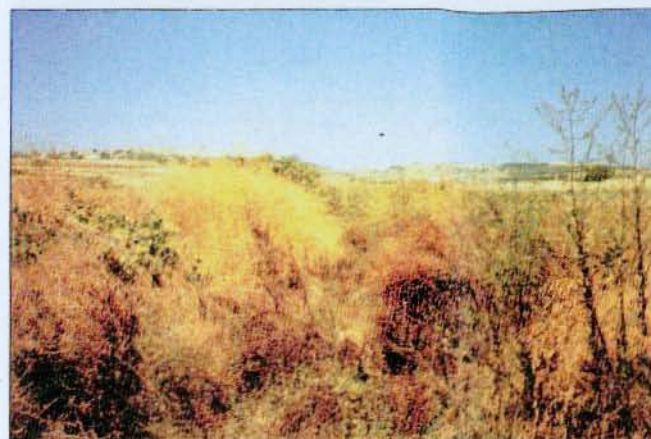
Fig. 12.5

River Sewda (see caption Fig. 12.1).

(a) Upper Wied il-Hemsija. Near source; good grassy buffer strips; in base of wide valley.



(b) Mid Wied il-Hemsija. Still small; a well-sunk channel in plain; narrowed, straightened, given uniform banks and bed.



gorges, around the river, the Rihana is deficient in interest, as it lies in near-flat lowland, hardly even rising at its sources. The Rihana now rises as two winding farm tracks, not at all obvious as streams. Then it becomes an obvious channel downstream of the road (where concrete has been poured as a temporary but deplorable way of channelling run-off water). Here water starts and, in wet weather, continues for much the length. Springs as well as run-off are presumably important. No Malta river is perfect, and the Rihana has been straightened, dug out, given too many exotic (instead of native) trees: the scenic effect is fine, the ecological effect,

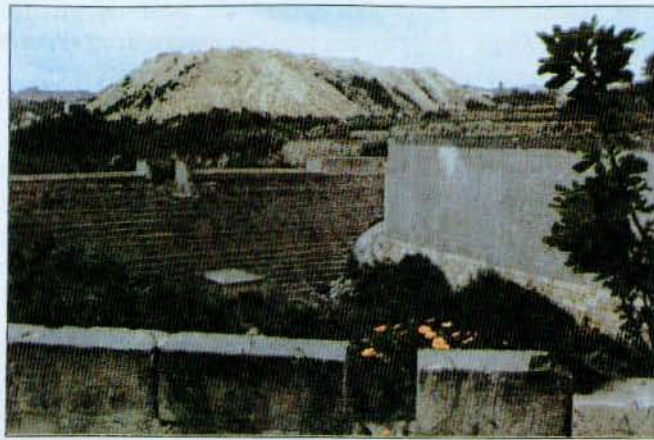


Fig. 12.5 (cont.)

(c) Upper Wied is-Sewda. Quarry upstream; dam; and to right, pig farm; wide, low bed.



(d) Pump house with buttressed built to withstand field flow. Wall on left overlooking into riverbed to form a wider road. Wied is-Sewda.

poor. However *Ranunulus trichophyllus*, in the 1980s, did well, a high compliment, and a good aquatic community occurred overall. Pollution increased, and in 1994, the vegetation had regrettably deteriorated, and by 1997 Blanket weed had largely replaced *Ranunulus trichophyllus*; *Typha domingensis* had increased too much, with various other species declining. There are dams, including the paved Good Luck Scheme type. The Arkata is mostly in a narrow channel beside a farm track (i.e. earlier the track was the stream), with clear water and a good flora. Naturally, water is removed for farming.

The final large tributary, the Wied Qannotta, rises beyond the Wardija ridge, soon becomes a "half-pipe"-shaped valley — rounded below — and

Fig. 12.5 (cont.)

(e) Mid Wied is-Sewda. Shallow bed about 8 m wide; soil, stone and *Globigerina* rock; man-made uniform banks; road crossing on rubble; rubbish, hunter-planted eucalyptus beside.



(f) Mid Wied is-Sewda. Bed as last, but impoundments dug, and severe pollution from pig farms; man-made banks raised; rubbish; variation of vegetation with level; (with pollution exposure and water).



woody. Tributaries quickly plunge down the gniien slope into woody gorges. Water supply is poor in the upper parts: collecting on the land is good, instead. Lower, the valley gradually opens, with less gorge, fewer trees and more farmland. The "Sense of Place" here is, as usual, unique. The channel gets bigger, springs start to appear (with a reservoir beside one of them), brambles or other plants may overgrow the bed, and new-style farm bridges and dams occur (walls and a bridge are breaking). The stream reaches about 8 m wide, with locally a very good aquatic flora. Down at the base, the Qannotta almost disappears. It dwindles into a shallow, grassed ditch dug straight across the Burmarrad plain!



Fig. 12.5 (cont.)

(g) Wied is-Sewda, Qormi. Showing upstream start of tarmac on bed; this confuses the river pattern; foot-bridge over "road"; sewage line shown by stone lumps (pipe laid in late 1980s).



(h) Wied is-Sewda, Qormi. Further confusion from tarmac on bed; "road" goes under a low bridge; this tarmac was laid earlier so vegetation is reappearing and the "road" looks different.

In any country the variety and value of the Ghasel would be outstanding, a just matter of pride to the inhabitants, and its conservation would be a matter of national concern. In tiny Malta, it is hardly short of wonderful, and it is much to be hoped that conservation will now follow.

The River Kbir System (Figs. 12.4 and 2.5)

This river system is even more complex than the Ghasel but, due to damage, a good deal is regrettably now of little value. Looking at the map



Fig. 12.5 (cont.)

(i) Manholes along road in Qormi running past the Central Chapels (behind), past St George's (centre) and down to Wied is-Sewda (right, far, not seen). These show the path of the former stream which watered all these, now converted to an underground sewer.



(j) Downstream Qormi, ugly.

(Fig. 2.5), the river has two main branches, Wied Hanzir and Wied Qirda, the Qirda being the confluence of several tributaries. The most interest lies in two of these (Wied il-Girgenti and Wied il-Luq), the Wied Qirda itself, the bottom stretch, Wied Cawqli, and parts of Wied Hesri, Wied Isqof.

The Luq and Girgenti both rise in great embayments in excellently-watered (originally!) gnien areas. Both arise on the Upper Coralline plateaus, with — before quarrying — a particularly nice delta formation for the Girgenti (i.e. a wide depression upstream, narrowing and deepening downstream until, after the end of the delta, an actual channel runs down the slope). The delta, before the Land Drainage Laws, was marsh. The Luq

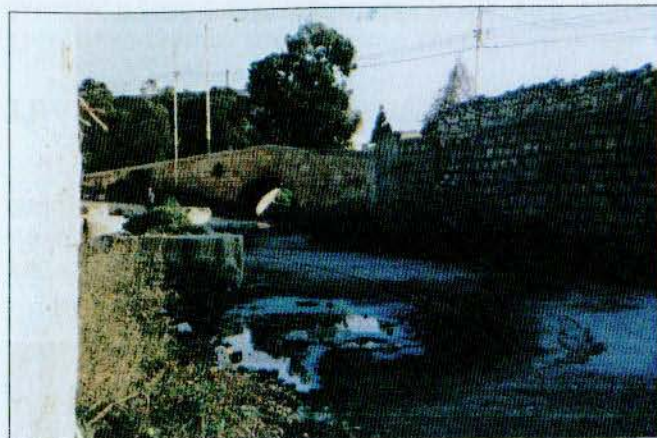
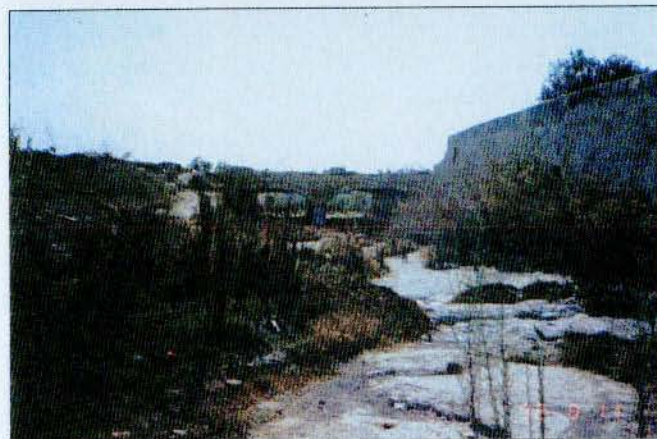


Fig. 12.5 (cont.)

(k) Wied is-Sewda, downstream Qormi. Still tarmac, walled, bridge; new run-off channel enters bringing pollution.



(l) Wied is-Sewda, near Kbir confluence. Part lined; bridge, Marsa.

and the Girgenti proper both supplied Knight's palaces areas with gravity-drained water from the river beds themselves, so showing water was present, in quantity, much of the year (Chapter 2). The Luq rises on a plateau, with a borehole at the top of the scarp, taking the river water at source. That, abstraction from other springs, and good percolation mean little run-off reaches the top of the stream. There, the channel is nicely ornamented and fully channellized, as is proper in a park, and having exotic as well as native trees is quite satisfactory. Shade, and damp-tolerating species (e.g. lesser celandine, *Ranunculus ficaria*) occur, and irrigation channels are present.

Fig. 12.5 (cont.)

(m) Wied is-Sewda, upstream Marsa Sportsground. Lined with land vegetation in summer, walled; in former Marsa marsh (as (m), (l), and (n)).



(n) Below. Wied is-Sewda, Marsa Sportsground. Severe pollution. Lined with ample (but unsatisfactory) vegetation; partial shade from planted trees and *Arundo donax* on sides; walled.



The Buskett park had only a few trees in 1586. By the early seventeenth century there were fish ponds (also used for water fowl), fountains, cisterns, orchards and vineyards, and groves of conifer and evergreen oak. Mulberries were added in the early-nineteenth century for the cultivation of silk worms, and more and more tree species were planted. The fish ponds were drained and turned in to citrus orchard: the two main ones are still known as the upper and lower sea. The stone irrigation system was started in 1610, part (including that used for the ponds) can still be seen. The open reservoir seen from the road, in the valley, started as a Grand Master's pond. Much laurel has been planted, as laurel branches were used in the mid-summer festival (Borg 1990a). By the bottom of the park the stream is winter-wet, with tadpoles etc. Beyond, *Arundo donax* dominates over a long



Fig. 12.5 (cont.)

(o) Wied is-Sewda, Marsa. Grossly polluted water; walled; exotic trees (acceptable in urban area).



(p) Wied is-Sewda, sea beyond far bridge; lined; walled, industrial and polluted; could come from any European country.

distance (Fig. 10.1), is a flood and conservation hazard, and should be mostly removed. The channel itself winds very suitably across the landscape.

The Girgenti also starts dry (Fig. 11.3), with, here, a bed farmed in part. Both here and in the Xaghri tributary there is also much *Arundo donax*, and maintenance is needed, so the winter-wet part starts some way downstream (as in the Luq). There are irrigation channels. The Xaghri has least water. The aquatic flora is quite good, in places neither winter-dry nor *Arundo*-covered. The extent of the pollution, even in a "clean" farming

Fig. 12.6

(a) Wied Incita, Government Nursery (exotic) water hyacinth, *Eichornia crassipes* grown on tanks to decrease water loss.



gnien embayment, can be seen by comparing (in Fig. 7.4) the sparkling clear spring water caught in a tank, with the turbid river water caught above a dam (*Myriophyllum verticillatum* is present in both: but with contrasting habit). The Luq and the Girgenti converge, forming Wied il-Hesri. Around this area (Ta' Brija) is the main settlement of river farms in Malta (Chapter 5). Water is still considerable, but of course nothing near enough for river farms to be built and used now. (There are a few other river farms on, e.g. Sewda, Gnejna, but only very few.) There is a borehole at the confluence, again taking most of the spring water formerly going to the river.

The upper Hesri starts wet, continuing the river farms and paved Valley Good Luck Scheme dams of the Luq. In the undredged i.e. unimpounded wet places of this area (e.g. close to the borehole itself), the aquatic habitat and flora are good. Going downstream, though, the Hesri moves into a gentle valley and then becomes a lane, without banks. The upstream water is quite lost (swallow hole? or ?), and the condition of the wied is in part deplorable and disgraceful, in part of high value. There are occasional brighter spots, for instance, an 1881 arched bridge with a small dam below. Otherwise aster (fennel) grass is the main community, where there is neither tarmac nor infilling rubble.

The Qirda shows a vast improvement, at the top even with perennial springs by the Siggiewi road bridge (though the water has recently much decreased, see Chapter 2). This water is regrettably over only a short length and now badly polluted. Passing a dam and a good deal of mess, with

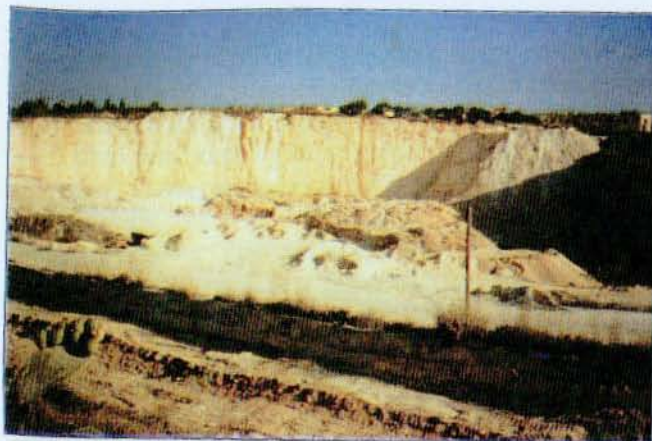


Fig. 12.6 (cont.)

(b) Lower Wied Incita. River passes through quarry; bed destroyed.



(c) Tributary near Attard. Small gorge; good rocky sides and base, with woody growth; exotics (acacia etc) escaped from Government Nursery.

pleasing bridge, the Qirda sinks into the deep gorge of the upper oralline, the longest of the spectacular Malta gorges. Woody plants are plentiful where they should be, along the spring line at the base of the arp, and where the steep valley side protects them from grazing. There are dams, and storm flow. The river bed has much fennel (*Foeniculum lagare*) even where it sinks low in the ground: a bad sign, indicative of messiness and disturbance. Some old dwellings grace the top of the scarp, but in general the Qirda gorge is without the historic heritage of that of the Ghasel. On the other hand, human impact (so far) is much less, and it can therefore offer a pattern of what the Ghasel could be restored to. Damage

Fig. 12.6 (cont.)

(d) Upper Wied San Martin. Shallow rocky gorge; deepening downstream, good structure; brambles (*Rubus ulmifolius*) in foreground; quarry far.



(e) Lower Wied San Martin. Rocky gorge with flat floor; good structure; satisfactory woody plants (along spring-line, and far); present narrow channel is winding on floor.



needs preventing in the Qirda gorge, though, and more needs doing upstream of the gorge. The bed has much infill, especially in the upperpart.

Downstream again is the Wied il-Kbir, the Great River Valley, in the strict sense. This is now a sad misnomer for this unfortunate and messed-about stretch of valley. The River Kbir system, on the other hand, is properly so called: this is the largest of the Maltese river systems (Latin *magna* = great, meaning both large and important). The wied starts in the gorge, Hanzir and deteriorates, getting more of the roads and more mess: the typical vegetation including aster (*Aster squamatus*) and sticky samphire (*Dittichia viscosa*). Part is even without satisfactory edging, other parts

have been dredged smooth — and dry. The bed can reach 20 m wide and more.

The basal section, Wied Cawsli, though entering the Marsa urban complex and necessarily affected by that, is, surprisingly, in much better condition, in parts. The bed widens, reaching 30m or even 50 m, edged by a bank, with trees, and by an appropriate urban wall. There is a nice arched bridge, though the downstream bridge near the Sewda confluence is dilapidated. The lower river is winter-damp (with e.g. *Rumex conglomeratus*), and the main part is grassed. This wide previously-marshy area was where the sea flowing into the Marsa estuary met the fresh water coming down the Kbir.

Looking next at the larger tributaries (Fig. 2.5), the Xkora river bed can be singled out as being (where accessible) awful: in shocking contrast to the Luq and Gircanti. It is much drier except with much rain. This is the primary cause of the trouble. It is easier to mess up a piece of dry land than one where much water makes roads, farming, off-roading, and anything else difficult (see, however, the Sewda below, and Chapters 10 and 11. It is not impossible to destroy a watered river habitat!). Where the wied is a shallow bed in flat land, it is at best a mess, at worst lined as a channel and as a road. Downstream there is a gorge, with pleasing terraced sides and much carob and other trees and overall charm, diversity and shade. An oasis in a desert! The vegetation is the usual fennel-mix.

The Isqof rises in a good winter-green vale with orchards and other woody plants. It dries too much, too soon, though. *Arundo donax* dominates part of the channel, but as the road runs beside and close, the *Arundo*, though a conservation hazard, is not a flood hazard, as flood water could use the roads. Well made dams and a range of bridges occur. Where the channel is walled, repairs are needed. Part of the bed is smooth, *Globigerina* rock, most is earthen. The vegetation downstream has prominent fennel, aster, sticky samphire and fescue (*Festuca arundinacea*), as usual in dry, disturbed channels. Tracks or lanes are frequent.

The Baqqija, being downstream of the Isqof, is of course rather wider, reaching 15 m or so wide. This is the river that defended Zebbug (Fig. 8.10), where, there is a dilapidated nice old bridge just upstream, and a rubbish site (oh dear!) in the town. The defences, the way of building and the road communications, even the pattern of erosion and decay, well worth study. This wied has only a little, mainly rain-fed water now. There are some impoundments with much aster. *Dittichia viscosa*, *Arundo donax* etc. are prominent on drier parts, grassy vegetation in damper ones.

The Kbir system is much degraded in comparison with the Ghasel. Less water has been allowed to remain, and disturbance is greater. The "hidden" valleys of the middle river are, when discovered a delightful surprise, but for valley, rather than water features.

The River Sewda System (Figs. 12.5 and 2.5)

The Sewda and Kbir both flow to the sea at Marsa. Earlier, both entered different sides of the Marsa marsh, but now the two join before the mouth, and as the basal part follows the general line of the Sewda, it is conveniently considered as part of the Sewda.

More than the others, the Sewda has a main river with but few tributaries. The river, here the Hemsija (and with its lower part variably called Wied ic-Campira), rises between Mdina and Mtarfa, in a wide gently-sloping vale. This lack of steep slopes continues along its length: the main Sewda has no large gorges, most is not even in a vale, it is just the river bed in a lowland *Globigerina* landscape. This is quite a contrast to the Ghasel and Kbir! There are proportionately more settlements: Rabat, Mdina and Mtarfa upstream, Attard (and now the new side of Zebbug) in the centre, then Qormi and Marsa downstream. The wied is more "developed" than the Kbir and Ghasel. The limestone caps of the Mdina (especially) and Mtarfa hills used to — and to a small extent still do — gush spring water, to run down to the Hemsija. The lane winding down from Mdina "Watertgate" (now marked by the Waterworks Department, still interested in the yet-running spring) carries under it the remains of one of these flowing tributaries. The channel is nicely marked by the Waterworks metal plates intermittently over it. This channel opens downstream, and is joined by the overflow from the clay pit reservoir (still a reasonable spring, full even in June), and formerly by the Mdina rubbish-disposal channel, before continuing, as a dug and lined (narrow) channel, to reach the Hemsija in the vale below. The waste-disposal channel is shown clearly in the 1890 picture by Gianni, but is now hardly to be traced: of course it is no longer in use. The Hemsija is partly channelled, partly just a valley base. Where channelled, 2–4 m is a common width. *Arundo donax* is frequent (and see Borg 1990b).

Below the Rabat road there is a proper channel (and a clay reservoir near the road). The channel is much too straight, it has probably been straightened at various dates, most recently in the Ta' Qali area when the airfield — the Crafts Village — was built. This last straightening was when

water was already little, and the planners had forgotten that straight channels in soft earth will, with water, revert to a natural pattern. Fig. 1.3 (5) shows this mobility of channel very nicely. There are scattered trees (including palms which are exotic), the bed may be earth, stone or rock, and the vegetation is commonly grass — sticky samphire mix, with aster and *Arundo donax*. Rubble has been dumped, and there are new farm bridges.

There are some well made dams upstream of the Zebbug road bridge, which, from drying, now have little use. Downstream of that they are mostly the paved Valley Good Luck Scheme type, some of which are already breaking down. Here, though, there is ample winter water and a high density of impoundments. Here also are a few (former) river farms, and present riverside use includes pig farms whose effluent causes moderate to gross pollution of the waters. The basal dams, above Marsa Sportsground, are of a unique type, frequent cross-pieces, in a completely lined channel (Fig 5.2). As the marsh was drained only in the 1860s, these old dams must have been constructed after that, with enough incoming water to make the construction worthwhile.

The Sewda bridges are satisfactorily varied. They include the unique one by the Zebbug road bridge (examine it from both sides!), old enlarged farm ones, new farm ones (deplorable, mostly), fine new highway ones, the unusual arched bridge at the mouth, and more.

By Attard, the wied passes through the Government Nurseries where, interestingly, till 1997 the (exotic) water hyacinth (*Eichorum crassipes*) was used to cover reservoirs, so decreasing water loss and cleaning the reservoir water. (These reservoirs receive run-off from Mount Carmel Hospital and roads, store about 600,000 gallons, and water about 80,000 trees and other plants yearly up to about mid-June.)

Downstream of Attard, come the quarries — the only short low gorge on the Sewda proper. There is some channel winding, with gentle turning, and a bed reaching about 50 m wide (with a deeper more recent bed within). The channel is much-walled. In the (Sewda) quarries, river banks are altered, water can percolate straight into the limestone: with all its storm run-off pollution, of course. Debris may raise the banks, machine debris may lie in the bed, there is a sand and spall quarry, and, by the Zebbug road bridge is a large insightfully hill of debris, raised and stacked in the past nine years, probably to be used as raw material by the quarry for its soft stone crushers.

Downstream of the quarry the wied has a developed but rural nature. An underground culvert built in 1991 brings water directly from the Misrah Kola newly developed area. The initial walled stream is filled (over-filled!) with *Ricinus*,

and the earlier — not much earlier! — greater water is shown by the buttresses on the Chadwick waterworks building jutting out into the channel (also see the access steps). Cart ruts are incised into *Globigerina* rock.

Approaching Qormi, impoundments, pollution, infilling for wider and new roads, and general mess increase. Hunters have, regrettably planted exotic eucalypts. Native trees occur too, and carob and vine are in the fields. The bed vegetation varies with groundlevel (i.e. water level), pollution and disturbance. None is at all satisfactory, and in the worst-polluted impoundments no higher plants can grow. *Aster squamatus* and *Rumex conglomeratus*, together with thick (Blanket weed, or pea-soup) algae, occur in the next stage up (Fig. 7.2). On drier ground upstream a variety of marsh and land plants can grow (including a very little — so as yet satisfactory — *Arundo donax*), but further down, human impact seriously reduces diversity, only ruderals increasing. Fauna include tadpoles, such birds as hunters permit, and domestic animals (dogs, horses, sheep and goats). Pipes etc. show both water removal and pollution entry.

Passing downstream, banks lessen, are less walled, and are mainly of the 1:1.5 slope favoured by engineers (with gentler slopes for the impoundments themselves). Scrap metal run-off occurs just before Qormi, from where the river is surfaced all the way to the sea: quite incorrectly at Qormi, where the undoubted mess should instead have been corrected in a way to preserve both natural and historic heritage. There is a sewer below the road.

Despite the asphaltting, though, Qormi shows some interesting foot bridges over dry roads and sewage markers (concrete lumps), two or three parallel roads etc, all showing where the river was, where the older roads were. Qormi is of course an old walled town (Chapter 6) and the streams on which it was built (or, rather, their underground usually-dry culverts) come out into the river.

There is still some farmland on the drained marsh between Qormi and Marsa Sportsground (with dams described above) but the lined bed prevents good aquatic habitat. In the Sportsground, where silt accumulates, quick-growing vegetation can too, and trees pleasingly overhang much of the walled channel (being an ornamental area, exotics are acceptable: species include acacia, casuarina, ficus, oleander, palm and pine).

At the Marsa road, water remains for much of the summer: disgusting, polluted water, run-off from dirty places like main roads, stables, and car parks. This has got worse in the past few years, particularly since the building of the new Santa Venera highway and tunnel. *Cyperus* formerly did well, but now is hardly able to tolerate the contamination. Downstream the river turns

completely, not just urban but industrial urban, with pipes for various purposes crossing, and only the Victoria Bridge (see chapter 6) relieving the general (and typical European) scene.

Much water of course, is abstracted. Boreholes are intermittent along the course of the river, the impoundments are used for farm water, and spring water is either gone, or used by farms. Some water remains, but as in the other rivers, most has been lost, and Qormi has done its best to obliterate that it ever was a historic and river-associated town.

Wied Incita is the main tributary marked on the maps, it has a slightly winding channel clearly straightened early with variable (steep) banks. Upstream is another charming woody and farmed source, rather like the adjacent upper Isqof. When some 4 m wide, and walled, it is usable as a track in dry weather, and the walls are part-overgrown. The remains of the ford and packhorse bridge, there in 1986, appear to be destroyed. The channel bends sharply and is deepened, beside glasshouses. The wied passes by Mount Carmel hospital, and here instead of just the river channel in a flat landscape, a minor gorge develops.

There is a short deeply sunk (near-gorge) channel leading downstream from Attard, which, presumably, was of major use to the village (waste disposal, access sediment, other?). It is now much-wooded, including exotic species which have escaped from the near-by Government Nursery.

To the east of Mount Carmel hospital is the Wied San Martin, not marked on most maps. It joins the Sewda near the Zebbug road bridge. The source is on flat ground, passing via a vale to the typical V-shape found in rocky karstlands. Vegetation is good and diverse, with briar and carob round the base. The bed is not river-worn, but rain-worn rock, showing this wied has long been dry. A fossilised system, perhaps? The bed becomes wider, reaching perhaps 15–20 m, with a diverse garigue community. Narrowing, the wied bed then remains about 5–15 m below the tops, passing a builder's yard (with cypresses) and an open, damaged storm-water tank, and the wied becomes a flat-bottomed, part-woody gorge, (including briar and *Arundo donax*). This then deepens with good vegetation on the less-steep faces. The San Martin is a little gem, the only such in the Sewda system. Therefore, of course, the base is destroyed by quarrying. The channel is cut off, which, given the nature of San Martin, would not create a flood hazard in a normal heavy storm.

Downstream tributaries are now mainly roads leading down into the valley or wied, and carrying storm water: water lanes, in fact, and with so much construction, it is only sometimes possible to say whether the road is on the route of the original stream.

The main waste from Mdina and Attard no longer enters the Sewda, but otherwise it receives much pollution. Agrochemicals come from farm land. There are major roads even in the country, and Attard, Qormi and all the urban area downstream have badly polluted run-off most unpleasant additions to the river. There are quarries and pig and other livestock units, some with really gross pollution. Livestock sludge is dumped actually in the river bed. The disgusting run-off, from the Santa Venera tunnel enters, and downstream pollution includes houses, roads, car parks, golf courses and industry. In view of this, one would expect management to have enhanced the purifying power of the river as much as possible (see Chapter 7). No attention has, in fact, been paid to river vegetation, oxygen, buffer strips or silt traps etc).

Apart from in the San Martin, impact is great, or indeed excessive. Nevertheless, scenically much is quite pleasing (and see Appendix 2), and repays study in how the "Sense of Place" is in part retained from the traditional pattern, in part created uniquely for the river (whether for good, e.g. parts near Mdina, or for bad, e.g. gross pig farm pollution, or as in the rather deplorable but typical industrial part near the mouth) and where "Sense of Place" is quite lost by general meddling, reducing all to a uniformity of mess that could be found almost anywhere.

Post-scriptum. Distressing dredging upstream of Qormi in 1998.

SOME SMALLER WIDIEN

The rivers chosen for inclusion vary geographically, from all over Malta, with one example from Gozo. They are varied topographically, from gorge to flat, and in human impact, from low, through farming to part-urban. (No real urban mess rivers are included: for such, see Figs. 7.5, 8.9, 11.2, 11.8 etc.) For species lists see Chapter 3.

Wied Babu (Figs. 13.1, 13.2)

The Babu is an example of a coastal gorge river, on the south coast. It is set in rural land, one of a series of such gorges. To the east and north are gentle terraces, with fewer to the west. The wied is Y-shaped, with a high modern bridge over the rocky west branch, and, what a surprise, rubbish, even in such a remote and beautiful place. There is an irrigation channel, supported high on a wall and stilts. It has stone of different ages, and now takes polluted and road run-off to irrigate fields. Upstream of the bridge is the first cross wall, forming a terrace across the valley, 1.5 m or so high. The vegetation is good and diverse, including woody species.

The east branch has a 6–10 m floor, crossed at frequent intervals with 1–1.5 m high, wide terrace walls (made of large stones), making small cultivated fields. The valley sides are nicely woody, with a high diversity. The bank and gorge architecture is fine, varied in shape and texture, made from both rock and soil, and from vegetation (tree, shrub, grass and herb). Deciduous trees seem to be most in damper parts. Only a little water is ordinarily found in winter. At the east side are old parallel walls, the west of these being the wider, in fact as wide as a causeway (over 1 m). This is the older of the two. There is a small but lovely arched bridge joining the two. Both bridge and arch bear good lichen flora. Presumably water used to fill the channel below. The walls are “beautified” with oil drums, in part.

An old-type wall occurs beside a rocky, brambly bed: with pomegranates. A (later) dry wall crosses the channel, which like others here, is not

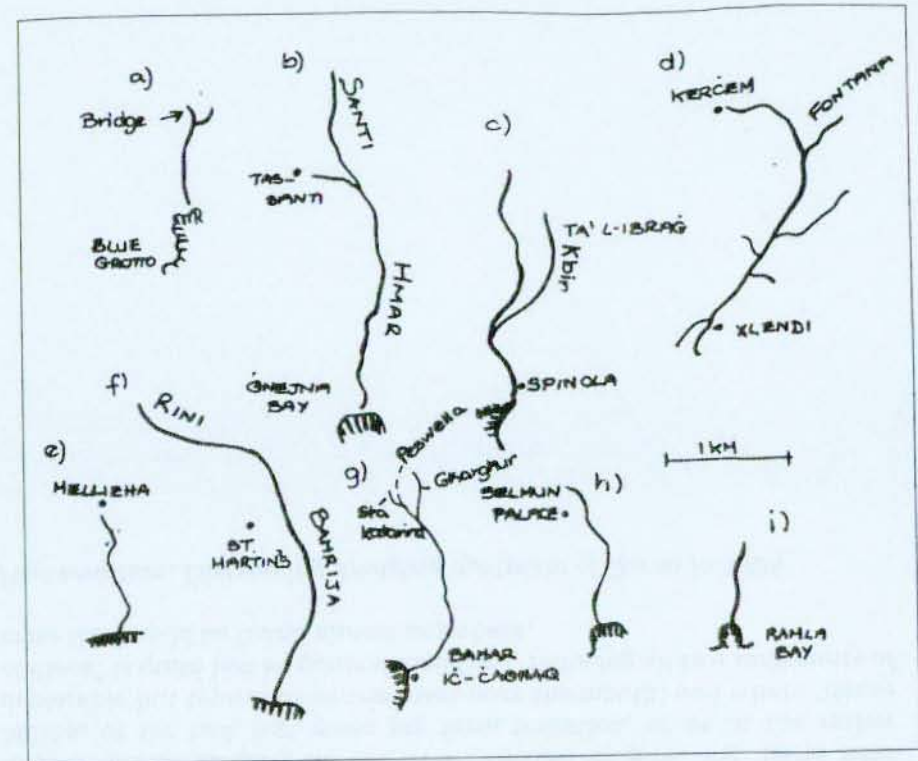


Fig. 13.1
River plans. (a) Wied Babu. (c) Wied Ghomor. (d) Xlendi Valley. (e) Mellicha Valley. (f) Bahrija Valley. (g) Wied il-Faham. (h) Selmun Valley. (i) Ramla Valley.

well maintained. Deeper in the gorge, cross-walls vary in age and type, and the floor widens. The sides and floor edges are delightful. The surveyor recorded “To me it is like a small paradise”. A channel (groove) sunk in the rock allowed water from the sides to run into the bed: at the period when spring water ran from the sides. The next cross wall is well-built, about 1 m thick, with a terrace drop of over 1 m. Surprisingly, in this remote area, the next field is a football pitch for the local boys! An unusual use for a river bed, even a long-dry one. The gorge walls are here so steep that woody plants, though still abundant at the edge, are sparse on the cliffs. The rock patterns are pleasing. The gorge narrows and becomes covered with briar on approaching the sea, and, as in common with these south coast gorges (see the Bahrija, below) the channel plunges down a cliff to the sea.

The Babu is beautiful all year, and conservation should lie mainly in leaving well alone, though rubbish could be removed, walls restored, and traffic and pollution prevented.

(Upper) Santi Valley (Figs. 13.1, 13.3)

This is an example of an embayment and two-stage wied. It exemplifies a different type of southern river, occurring further west along the coast to the Babu. The wied first flows west, parallel to the coast, and later turns south to the sea (at Gnejna Bay). Above, there is a delta (a former marsh). Then the Santi proper starts as a large cwm (embayment) in the upper Coralline limestone. There is a gnien farm on the top of the scarp (Fig. 5.9), and good gnien areas are round the cliff base below, with springs further out also. The top is garigue or farmed, the scarp bears woody plants, and the old pattern of springs, and spring water gathering to streams, is well seen. The cwm floor has large, good-quality fields: here is land optimal for crops. Walls cross the cwm, giving terraces on slopes.

Down from the cwm, the valley remains wide, with scarps above though here there is terracing (i.e. steeper, slopes) under the scarps, and a clear stream bed on the valley base. A wealthily-built farm complex is on the gentle slope. A good buffer strip occurs by the steep narrow stream channels: these have moved a little since last dug; note the earth is clayey, so the channel can be dug narrow without the sides falling in, and the start of winding and eroding bends. *Arundo donax* marks some stream lines, occurring along banks, and cross channels, and is harvested (and left to dry in fields) as in the past. This wide V-shaped vale is of course on *Globigerina*. Down, it widens more, but is still a V with scarps above. The inner valley, though, steepens to become the immediate wied valley in its own right. Intermittently, *Arundo* masks the stream centre. Only the scarp and gnien areas are wooded, though prickly pear (*Opuntia ficus-indica*) hedges and patches are prominent in this central area.

The main river here curves sharply towards the sea, but tributaries from inland (north) flow down to join it. These are marked under the scarp by *Arundo donax* bands. Prickly pear hedges add to the scenic value of the landscape, oil drums detract from it. The next crossing of the river shows that this channel, upstream of the bridge, is just a walled track, not well maintained. Downstream it is a river bed, with much cape sorrel (*Oxalis es-caprae*). Several inland tributaries flow in from under the scarp, where

Fig. 13.2
Wied Babu (see caption
Fig. 12.1).

(a) From above, to show general configuration and two valleys at the head; woody plants scattered on the top, and more below.



(b) Looking downstream into valley; with solid soil-retaining cross walls (and track across, centre); farming on floor, much woody growth at sides and on gorge walls.



there are good gnien lines, as usual. A wide, gentle *Globigerina* valley passes to the sea, with more *Arundo*.

The top cwm was fully watered by the many gnien springs. It must have been partly marsh, or indeed pool in winter. The drainage date is not certain, at present. The water would have flowed well from this area, with more water added downstream from the scarps, and until quite recently there was surely much water here (in the next valley, Gnejna, flowing water is nearly perennial still).

The Santi, like the Babu, is a remote valley, but unlike the Babu it is a working farming valley, continuing many of the old patterns: though not



Fig. 13.2 (cont.)

(c) East side. Old walled dry channel: more of a causeway to right (older); woody growth up the gorge.



(d) Old arched bridge over the watercourse of (c); damp habitat and vegetation.

the old watercourse. The cwm waters would have come together as a proper river downstream in the vale. This is a highly satisfactory wieden.

Wied Ghomor (Northern) (Figs. 13.1 and 13.4)

The Ghomor contrasts sharply with the Babu and Santi. It is sited on the north, and is surrounded downstream, and round part of its tributary, by built-up areas. None is remote, all are affected by disturbance and urbani-

Fig. 13.2 (cont.)

(e) Cross retaining walls as valley narrows; bedsoil above, more stony below; still much woody growth.



(f) Field now used as a boys' football ground; retaining cross wall far; rocky gorge; with much woody growth at side and on lower gorge.



zation. There is abandonment, but no remote or widespread good-quality farming. As the source is only 4 miles from the source of both the Santi, and the Liemu (Ghasel), Maltese diversity is well exemplified! The top is Y-shaped, like the Babu, and like the Babu, is very dry, Fig. 13.4 (a) being representative. A chapel is on the top of the slope. The bed is walled and rocky, with farming around, and aster, fennel and sticky samphire (*Dittichia viscosa*) prominent (the typical community in a dry, disturbed bed). Once more there is a strong "Sense of Place", and this sense is of dilapidation, unlike the two previous wieden! There are dams (well-built), and carob trees. The channel reaches 8–10 m wide in its middle section, and more,



Fig. 13.3

Upper Santi Valley (see caption Fig. 12.1).

(a) Embayment in the upper Coralline limestone with spring-line below the scarp; gnien farm on the top above the cwm.



(b) Wide cwm with farming; woody plants along the gnien; springs still present.

further downstream. Dense land vegetation on the bed becomes crops downstream, and settlement appears on the tops above this wide *Globigerina* valley. Fields and fennel-mix continue, and the valley steepens on approaching the Regional Road bridge. The land is near-barren, with the fennel-sticky samphire mix, and there is a track beside the rocky bed of the watercourse. The watercourse banks become steeper, with good carob, prickly pear etc along the sides. Scenically, the mix of tree and herb is all right, but the general impact of human activity has drastically reduced the species diversity. This is not Wied Babu! Two photographs are presented (Fig. 13.4) taken 5 years apart. The land form is maintained. Active

Fig. 13.3 (cont.)

(c) As cwm passes into valley, the floor narrows and the stream channel, marked by bands of *Arundo donax*, is formed; note the cwm, gnien and scarp behind.



(d) Stream winding on the valley floor, with a diversion channel (front, without *Arundo*); *Arundo*, though frequent, is in thin patchy bands kept so by regular harvesting; gnien habitat on valley side much reduced; good buffer strip.



farming has almost gone, and, most strikingly and importantly, with abandonment (no cutting, no grazing) trees have grown outstandingly. This abandonment of farming land is the result of land exploited by developers as the new buildings, overflowing in to the valley, show. The new scattered buildings overlooking further down to the lower parts of the valley prove the points. This is a lesson for development elsewhere in Malta, and a good lesson for schools to study also.

Downstream again, buildings increase, and have increased more in the last few years, mainly for recreation.

The wied comes out at tarmaced Spinola, where underground chan-



Fig. 13.3 (cont.)

(e) Valley is a wide V with no (wide) floor, the stream channel is at the base, winding with the hill slope; (contrast (d), a mobile channel); good farmland on the slopes above.



(f) Further from the spring line the river is a walled track, with land vegetation, though muddy and wet in wet weather.

nels lead to the sea, receiving also local run-off. St Julian, in his statue, presides here.

The Kbir tributary of Wied Ghomor rises in a small, just Y-shaped embayment and cwm set in a scarp, with a similar head between this and the Ghomor. The northern one is a larger and steeper gorge. There is what should be, and earlier was, a gnién edge below the scarp (the spring exits can still be seen). The tops around are largely built-up, funnelling run-off here after heavy rains. The eastern sources, less built up, has a delta on the plateau above. The Kbir slopes are steeply terraced, with narrow fields — and hunting and trapping. One slope is mostly farmed, the other, mostly

Fig. 13.4

Wied Ghomor (see caption Fig. 12.1).

(a) Walled and rock-bounded channels; in lowland in bed affected by dumped rubble (*Foeniculum vulgare* etc., some woody plants at side).



(b) In wide, farmed, terraced valley; walled channel with land vegetation; built-up on tops.



abandoned. The wall maintenance is poor. Tiresome work, like walls and (here) farming are often given up in wealthy newly-built areas. (More money can be made from many urban activities.) It is worth comparing the "Sense of Place" of the Kbir (Fig. 13.4) with the Santi (Fig. 13.3), comparing the false-remote with the true-remote, and identifying the features comprising this "Sense of Place". Treatment matters. Wealth matters: and acts quite differently as old wealth and new wealth (the latter degrading traditional farming).



Fig. 13.6 (cont.)

(c) Valley floor wider and farmed, with cross walls; road built over part of bed (see basal line of valley).



(d) Valley lessens on approaching the sea, becoming a fairly narrow shallow depression.

than the valley, so the river is being deprived of most spring water (by drying) and rain water (by roads). However, during 1994 whilst clearing the rubble close to the Mellieha washing place, below the S-bend road, a small spring was found, which hitherto seeped into the fields. The washing place was repaired, with the spring feeding it before being used on the farm. St Mary's cave, genuinely old, unlike the modern ornamentation of the Speranza cave (Chapter 9), bears, like the other, a statue of the Madonna and Child, with plenty of ex-voto offerings. It has a spring, its water now labelled unfit for drinking. (Unfortunately typical, see Chapter 9.)

The valley is farmed above, to some extent, as gardens. One valley side

Fig. 13.6 (Cont.)

(e) Downstream of the road in (d), the stream continues underground and comes out as shown here; much run-off water is expected (from the construction) from even this small catchment.



Fig. 13.7
River Bahrija; Wied ir-Rini, upstream and Wied Bahrija, downstream (see caption Fig. 12.1).

(a) Open garigue looking to wide (upstream) end of "delta" ex-marsh in depression.



is built-up, the other has decaying farming. The small fields of the upper valley continue down, but become overgrown with scrub. With the removal of most of the water (see above), this is hardly a flood hazard. The valley bed in this part slopes steeply, and the valley sides are steep also. There are narrow fields and high terrace walls (more effort used to be put into farming than is now, with tourist and other wealth). There is a small watercourse at the side, with running water in wet weather. Further down, new housing faces the sea. The valley opens out, with a central channel only about 4 m wide. This flanks the road on the right and the brook passes under the main road, and comes up in the housing estate, with no river



Fig. 13.7 (cont.)

(b) Walled channel in base of valley; fields beside; vegetation shows negligible present run-off.



(c) Below present permanent springs; bed perhaps straightened at base of valley; buffer strips beside; *Arundo donax* dominant, with local *Scirpoides holoschoenus* etc.

channel, just as part of the road. Clearly, a flood, collecting run-off from roads as well as from valley bed, would be more than a nuisance. It would be a hazard, for erosion of the road, as well as flooding the houses.

In a very short length here the Mellieha wied shows a former gnien area; a farmed part close enough to the town to be protected from raiders (if the town was protected); a cave with a holy spring and Madonna; water removed by drying and road diversion of run-off; run-off added again near the bottom; woody overgrowth; an underground channel; and floodwater allowed loose in a housing estate.

Fig. 13.7 (cont.)

(d) Water clear but not clean, several aquatic species (including Blanket weed).



(e) Channel intermittently dominated by *Arundo donax*; becoming drier (water loss after (c), (d)); farming now patchy.



Bahrija Valley (Figs. 13.1 and 13.7)

This river rises, named Wied Rini, on karstland with short garigue, on the south of the island, towards the west. There is a nearly delta-shaped depression in the karst, the narrow end forming the start of the channel (over more this used to be a marsh). This is messed up with rubble and rubbish, and fennel (*Foeniculum vulgare*), a ruderal, is invading the garigue. Further down, the bed sinks to maybe 10 m below the tops, and is farmed, with a walled track at the side. Ordinarily such a track is the



Fig. 13.8.
Wied il-Faham (see caption Fig 12.1).

(a) Looking to head of near-cwm valley (St Katarina), with St Catherine's (ex-marsh) farm above, centre; farming "delta" above tributary wied to right; terraced farming on steep slopes; woody plants on walls etc, especially at head (perhaps a remaining spring-line influence?); valley floor farmed, with cross walls in steps; well.



(b) Valley narrower; floor still farmed, with cross walls and no surface low channel; slopes moderate, terraced, cultivated on near side, some abandonment far; trees decreasing downstream (except on heights); fireworks factories on slope.

watercourse, but here it lies higher than the fields (the earlier digging pattern is needed, to understand the design). Further down, a typical low-set watercourse occurs, with carob, fennel etc, and where it is well-walled and about 4 m wide, it bears asparagus, fennel and ruderal vegetation, and a cross-wall has water holes (around 0.5 m above the ground on the downhill side. Water was, clearly, expected to be this high, at least during storms). Farming, including orchard, continues over the bed, but not continuously: the watercourse bed varies from narrow to wide, with *Ricinus communis*, *Arundo donax*, grasses etc or again with cultivated fields. Olive, fig and other woody plants edge the wied. There is a reservoir

Fig. 13.8 (cont.)

(c) Valley floor now a (dry) watercourse, with land vegetation (starts at secondary cwm head); concreted farm crossing in the middle distance with track almost along contour; terraced slopes near, yielding to rocky slopes far, as river descends through the Coralline scarp.



(d) V-shaped gorge with land vegetation on floor, tall garigue on rocky slope with terraces (some now farmed) above near, scarp far.



and, unfortunately, oil drums.

With the change of name from Rini to Bahrija, water now occurs: this is one of the few streams with water flowing all year, summer and winter. Naturally much is abstracted (for table water as well as the usual purposes) so the water is little compared to that of earlier days. This is important, since stream flow in summer is, in general, so little. It really used to be much more!

This incoming water was, of course, properly employed. A hamlet of appropriate size to use, not over-use, it, developed. It had a complex of collecting tanks, irrigation channels (including one raised on stilts with later infill) and a very nice wash place. This is in sections (in a 1 m wide



Fig. 13.8 (cont.)

(e) Looking down scarp to plain below; water-course a track in middle distance; flowing to the sea at Bahar ic-Caghaq, far right; dam near top of scarp (bottom left) helps to keep downstream section dry (in normal storm flows).



(f) Looking up water-course bed (a track); from the plain to the scarp (e).

channel), and is now used for rinsing vegetables, formerly for laundry. Very properly, the downstream rock-hewn section is used for the first dirty wash, the upstream too for the final cleaning. Before the pattern vanishes under "progress" the water system should be fully mapped, and its history and use be discovered from the inhabitants. The aquatic flora and fauna need recording also. (Farm bridges need study for height and slacing.) The Bahrija water is sparkling clear, even in summer, in contrast to the Girgenti (see Chapter 12). Downstream, water decreases, little spring water goes to the river, and *Arundo donax* overgrowth becomes all too common. This is a flood and conservation danger, and should be abated.

Fig. 13.9.
Selmun Valley (see caption Fig. 12.1).

(a) Looking upstream at farmed "delta" (ex-marsh) in depression in garigue, widening in distance.



(b) Farmed "delta" narrowing at downstream end (right).



Aquatic flora is potentially good, but is restricted to those few places where (as by the path from Bahrija village) the *Arundo* is prevented from dominating (when *Apium nodiflorum*, *Mentha pulegium*, *Scirpoides holoschoenus*, and others, grow well). Because of the incoming springs, water-use systems continue down to this region. At the ford the water is still clear and sparkling, but it has passed through too many farms and houses and so is no longer clean. This is shown by the Blanket weed (green trailing algae) so visible in the lit areas.

Down from here *Arundo* dominates over far too much of the bed, springs and stream flow decrease, except for rain flows, but there are two dams,



Fig. 13.9 (cont.)

(c) Walled channel descending woody slope; minor road beside, hardly interfering with channel.



(d) Well-constructed dam in wooded valley; must have been enough water to make this worth building.

with (unfortunate) concrete spill ways showing inadequate design. Clover can be grown and harvested in the bed. The valley here is wide, with moderate slopes, well-farmed below, and with garigue above. The water remaining in the dam pools is likely to be rather turbid. Downstream the valley is drier again, still with intermittent *Arundo* overgrowth, and at the east, like the Babu, the channel just spills over the cliff and drops to the sea. That channel is rain- (not river-) worn and lichenized, showing recent flow has been negligible. (See fig. 9.2 for the difference between river-worn and rain-worn limestone.)

The Bahrija has its main water sources in the middle, not at or near the

Fig. 13.9 (cont.)

(e) Below scarp, in wide, terraced, farmed valley; steep slope to sea far; woody plants in valley base, and above; channel winds with landscape and positioning of terraces; *Arundo donax* marks some of the damp areas.



(f) Walled channel with brambles (*Rubus ulmifolius*), fig (*Ficus carica*), *Arundo donax* etc; channel is not on the lowest line of the valley so has, earlier, been diverted (see (e)).



top as on gnien-lands, or well downstream as in rivers rain-fed and with low-lying *Globigerina* springs. Much of the water is 30–50 cm deep in an average winter. The (nearby) delta starting on the karst is typical — but pleasing. The total amount of spring water is important, and should be maintained.

Wied il-Faham (Figs. 13.1 and 13.8)

This is a cwm river, rising in deep but narrow embayments on the Naxxar heights, the main Faham source being the Santa Katarina (which becomes



Fig. 13.9 (cont.)

(g) Channel drops sharply down steep slope to sea (see (e)); with, finally, a cliff to the beach; this cliff was earlier protected by a semi-circular wall, now decaying; flowing water seeps through and under this wall; *Arundo donax* on sides (drier parts) of channel above.



Fig. 13.10
Ramla Valley (see caption Fig. 12.1).

(a) Gentle slope in garigue etc at head of valley; no full "delta" as in Fig. 13.9.

the Dis, downstream). The Peswella is a close tributary to the south, and the third source is from under Gharghur village. There is (or rather was, as recent houses and other construction blot out part) a good delta (ex-marsh) in the karst above the main source. The old farmhouse here is, like the wied, St Catherine's. The scarp descent is steep, terraced and farmed, not a rocky cliff. The valley floor is farmed, with cross walls, high when bounding the wide floor. Some walls, terraces and part of the floor are woody.

Gharghur has another cwm with terraced scarp, a flat floor and cross

Fig. 13.10 (cont.)

(b) Well-defined channel, sides partly rock, partly man-made; loose rubble; land vegetation in bed.



(c) Small "gorge" with scree, rock, terraces etc on sides; farmed; no channel on floor; cave room far, stoned round entrance; some woody plants on floor and sides.



walls (the walls are not strong enough to withstand flood-moved soil, like the main Faham, so showing such floods are not expected). Terrace walls are falling. Gharghur itself is on the flat top above the cwm (including the Lady Chapel, see Chapter 9).

Passing down the valley, two subsidiary "cwm heads" are found, places where semi-circular dips form new cwms within the existing one. At one, there is a very old valley crossing point (the lanes along the contour can just be made out) and a new tall piered bridge, with its roads much higher than the old ones. The afforested escarpment of the Madliena and radar station area adds variety. There are access steps, as expected with an old crossing.



Fig. 13.10 (cont.)

(d) "Roadside ditch"; narrow channel by minor road, flat beside; functional water source above.



(e) Narrow V-shaped rocky wied, dominated by woody plants (brambles, *Rubus ulmifolius*, etc).

The next crossing downstream has had concrete poured over to (temporarily) make access easier, and — probably more permanently — obliterate the past pattern. This is vandalism. The old lanes running along the contours can be seen easily, and there is a new farm track, too.

Along this stretch the valley has continued as a wide U-shape, with terraced sides, and farming and maintenance of variable quality. The bed is usually dry, but below the second instream cwm head, the river bed has been stony, not like the cultivated top.

Fig. 13.10 (cont.)



(f) Wider channel with man-made sides; pipes under road, far; grassy vegetation.

Downstream the wied narrows, developing to a V-shaped gorge with garigue. The garigue is in a particularly good state on the steep sides where access is not easy. Diversity, plant height and species composition are all good. Woody plants even grow on the bed (which is drier here than further up). Sharply, then, the Coralline outcrop ends, and the wied drops down into the plain below. Here the watercourse becomes a farm track: but at least it does bear water in ordinary wet weather, as it does not, further upstream! Farm buildings and *Arundo donax* partly fringe the track, which soon separates from the road as a proper stream bed (dug out) shortly widening into a partly (unconstructed) depression which passes down to the sea at Bahar ic-Caghaq. Just upstream of the village is a river-worn rock bed, partly covered with lichens: showing this river dried sooner than the, e.g. Ghasel.

Looking under the coast road, the large channels show provision was made for much water to flow under the road (from the Faham) to the sea. This road was constructed decades ago. Looking instead at the placing of houses in the new settlement of Bahar ic-Caghaq, it is equally plain that little provision has been made for abundant flood water.

The Faham is, once more, a very different type of wied. Narrow deep cwms at the top, flat plains at the bottom, and abundant gnien water absent for a long time now, all make a different land form. There are also interesting chapels not just at the top of the Gharghur scarp, but also on the downslope to the plain, and in the plain.

Selmun Valley (Figs. 13.1 and 13.9)

This is a fascinating and little known wied, flowing north to the sea from near Selmun Palace. With a road all the way to the coast, it is highly recommended.

The source is a delta (or ex-marsh) in karstland, here seen more plainly than perhaps any other from ground level (aerial photographs show them well). The wide upstream depression is farmed, the upper karst level bearing garigue where it is not built upon. The farmland narrows downstream, and a narrow, sunk (dug) channel develops in little-cultivated land. The valley floor sinks down into a gorge in the Coralline limestone, the channel becomes walled, and a very good woody community develops in the valley. A wall, with small apertures for water flow, crosses the valley, though the winter vegetation is of land species in a year of average rainfall. As the valley floor widens downstream, it becomes cultivated, and is without a channel. This is followed by a well-made dam; so when it was made, enough water to fill the reservoir must have been expected! Fruit trees and orchards are common here and continue so, downstream. The valley becomes wide and terraced, *Arundo*, bramble, and fig are among the plants prominent in the channel, which is becoming drier. There are many and nicely patterned terraces and other walls.

Finally, there is a sudden drop to the beach. The cliff here was bricked in a semi-circular pattern. This was done efficiently, for some military or other valuable but now forgotten purpose. It is decaying. On the cliff itself, water seeps from both the rock, and from under the *Arundo*-dominated stream channel above. Apertures were provided in the wall.

This is a good example of a wied with low disturbance (apart from building above, and visitors below), good traditional management, but serious water loss. It shows, in small scale, a remarkable number of representative Maltese wied features in land form, "wild" and farmed vegetation, dam, bridge and similar.

Ramla Valley (Figs. 13.1 and 13.10)

This is included as an example of a short wied lying on open garigue karstland, with little change of land form or terrain. It passes northwards over the Marfa peninsula, the top of which bears a young woodland.

The Ramla starts as a gentle slope in the garigue, gradually developing

into a small channel, which is joined by other, similar tributaries. It develops further into what could be called an exceedingly small gorge, one with a floor 10–20 m wide, and sides about 5–10 m high. The floor is cultivated, with a rocky channel, the walls may be stoned, rocky, scree with vegetation, etc. Later, the "gorge" opens up again (past the Coralline ridge) and the wied passes down a brambly slope to form a flatter, straight, (dug) ditch-like channel which runs beside a minor road, and widens (to 4–6 m) at the mouth by the sea where it has dug-out banks.

This wied should be seen last; seen early, it appears nothing. Seen after studying much larger examples of land forms, these can be seen to be present in miniature.

REMEDIAL: TO DECREASE THE DANGERS TO HUMAN LIFE AND HEALTH

This is the first of three chapters on recommendations, following the description of the widien and attendant dangers in Chapters 10–13. Flood hazards, pollution (in aquifer, fields and watercourse) as well as the cleaning of water and of air are described in this chapter. Recommendations are made both to present and to rectify hazards.

Remove Obstructions to Water Flow

- Remove flood-removable rubbish, rubble and debris (see Chapter 15).
- Remove gates and fences across watercourses. Where such removal endangers (child?) life, redesign and reconstruct the hazard. Where desk studies show that even in the heaviest expected storms, the obstruction will not be hazardous, the gates can stay, depending on valley width.
- Remove constructions narrowing the flow path of watercourses, and prevent more being made (with the same proviso as in (b) above).
- Check the height of all dams and built-up roads across valleys (those without suitably-sized tunnels below), and lower or remove those found unsafe.
- Remove most *Arundo donax* where this is a choking dominant across the flow path in valleys liable to flood. It is satisfactory to have *Arundo* in steep, narrow watercourses; on banks where a good flow path is left in a wide watercourse; dominating the watercourse, if a road hardly above bed level runs beside the bed to carry storm flow, and this is in quantities small enough to create no hazard. (Removal for conservation is more rigorous, see Chapter 16.) Farmers do not have the right to use public land, or to prevent others having access to it, to the public detriment and their private profit. Public access may be prevented by the growth of *Arundo*. *Arundo* in large quantity should instead be on

Ceterach officinalis
Conium maculatum
Convolvulus tricolor
Crocus longiflorus

Melilotus oleagnus
Melissa officinalis
Ononis mitissima
Ophrys sphegodes ssp
melitensis
Orobancha hederæ

Verbascum creticum
Veronica polita
Vicia hirsuta
Vicia villosa
Vitex agnus-christi

Table 3.4
Prominent Dry River Bed Species

Common:	<i>Ceratonia siliqua</i> (dry, usually planted) <i>Dittichia viscosa</i> (very dry) <i>Foeniculum vulgare</i> (not summer-wet, disturbed) Grasses (various spp., often disturbed)
Frequent:	<i>Arundo donax</i> (damp) <i>Aster squamatus</i> (winter-damp) <i>Capparis spinosa</i> (dry) <i>Chrysanthemum coronarium</i> (not wet, disturbed) <i>Festuca arundinacea</i> (fairly damp) <i>Galactites tomentosa</i> (dry) <i>Rumex conglomeratus</i> (damp, wet, and summer-dry)

The Changing Nature of River Vegetation

These changes have come from human impact, which may be divided into:

- drying, loss of water;
- disturbance (in all its forms, from dumping to off-roading and concreting);
- pollution.

Reading Table 3.3 and the descriptive section of this chapter (below) suggests all is very well: aquatic species, marsh species, species up the sides of valleys are many, with diverse habitats and sub-habitats. Reading Tables 3.1, 3.2 and 3.4 gives a very different picture: too many species endangered (many more rare) and only a few regularly prominent, most of which are undesirable or thoroughly undesirable in rivers, and none of which are aquatic, only one (*Rumex conglomeratus*), typical of marshes. There is all too much evidence, both from past Floras and from recent research, to show the trend is from good to bad (not the reverse). That is, while widien were once mainly of high quality, they have become of good quality only locally. Far too much is

6. Valley plants of arid places (habitat overlap with last)

<i>Aegilops geniculata</i>	<i>Fumaria thymifolia</i>	<i>Periploca angustifolia</i>
<i>Aira caryophylla</i>	<i>Hainaraia cylindrica</i>	<i>Phagnalon graecum</i>
<i>Allium chamaemol</i>	<i>Hippocrepis ciliata</i>	<i>Rosmarinus officinalis</i>
<i>Althaea hirsuta</i>	<i>Linaria pseudolaxiflora</i>	<i>Salvia fruticosa</i>
<i>Avellina micheli</i>	<i>Narcissus serotinus</i>	<i>Serapias vomeracea</i>
<i>Centaurea melitensis</i>	<i>Ophrys holoserica</i>	<i>Spiranthes spiralis</i>
<i>Centaurea solstitialis</i>	<i>Ophrys lunulata</i>	<i>Trifolium cherleri</i>
<i>Cistus incanus</i>	<i>Ophrys lutea</i>	<i>Vulpia bromoides</i>
<i>Crupina crupinastrum</i>	<i>Ophrys pallida</i>	<i>Vulpia fasciculata</i>
<i>Cynoglossum creticum</i>	<i>Ophrys speculum</i>	
<i>Dittichia viscosa</i>	<i>Ophrys tenthredinifera</i>	

7. Valley plants of the fields etc

<i>Allium dentiferum</i>	<i>Gladiolus dubius</i>	<i>Muscari parviflorum</i>
<i>Bellevalla romana</i>	<i>Lagurus ovalis</i>	<i>Ornithogallum arabicum</i>
<i>Chrysanthemum segetum</i>	<i>Linaria chalepensis</i>	<i>Ornithogallum umbellatum</i>
<i>Cichorium intybus</i>	<i>Muscari neglectum</i>	<i>Tragopogon hybridus</i>

8. Valley plants of waste places

<i>Allium dentiferum</i>	<i>Echium plantagineum</i>	<i>Rhagadiolus stellatus</i>
<i>Cichorium intybus</i>	<i>Foeniculum vulgare</i>	<i>Sinapis alba</i>
<i>Dittichia viscosa</i>	<i>Gladiolus dubius</i>	<i>Sorghum halepense</i>
<i>Echium italicum</i>	<i>Lamarkia aurea</i>	<i>Tragopogon hybridus</i>

9. Valley plants of grassy places

<i>Rhagadiolus stellatus</i>	<i>Vicia tenuissima</i>
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10. Valley plants of more general habitat (some)**(a) Frequent species**

<i>Anthyllis tetraphylla</i>	<i>Foeniculum vulgare</i>	<i>Orobancha pubescens</i>
<i>Arum italicum</i>	<i>Galium tricornutum</i>	<i>Phagnalon graecum</i>
<i>Arundo plinii</i>	<i>Geranium dissectum</i>	<i>Phagnalon rupestre</i>
<i>Asperula aristata</i>	<i>Lathyrus clymenum</i>	<i>Phalaris minor</i>
<i>Bromus madritensis</i>	<i>Lathyrus ochrus</i>	<i>Plantago serraria</i>
<i>Calendula suffruticosa</i>	<i>Medicago intertexta</i>	<i>Ranunculus muricatus</i>
<i>Catapodium rigidum</i>	<i>Medicago littoralis</i>	<i>Rubus ulmifolius</i>
<i>Centaureum pulchellum</i>	<i>Medicago polymorpha</i>	<i>Sanguisorba minor</i>
<i>Convolvulus althaeoides</i>	<i>Medicago truncatula</i>	<i>Scorpiurus muricatus</i>
<i>Coronilla scirpoides</i>	<i>Melilotus infesta</i>	<i>Trifolium stellatum</i>
<i>Dactylis glomerata</i>	<i>Melilotus segetalis</i>	<i>Vicia leucantha</i>
<i>Dittichia viscosa</i>	<i>Narcissus tazetta</i>	
<i>Erodium malacoides</i>	<i>Nigella damascena</i>	

(b) Infrequent and rare species (some locally frequent)

<i>Allium triquetrum</i>	<i>Delphinium halteratum</i>	<i>Parietaria lusitanica</i>
<i>Ambrosia maritima</i>	<i>Echium sabulicola</i>	<i>Phyllitis scolopendrium</i>
<i>Aristolochia clusii</i>	<i>Echium vulgare</i>	<i>Quercus ilex</i>
<i>Asplenium trichomanes</i>	<i>Eruca vesicaria</i>	<i>Salix alba</i>
<i>Atractylis cancellata</i>	<i>Freesia refracta</i>	<i>Sedum stellatum</i>
<i>Bromus alopleuros</i>	<i>Ipomoea acuminata</i>	<i>Stachys occymestrum</i>
<i>Capnophyllum peregrinum</i>	<i>Malope malachoides</i>	<i>Tamus communis</i>
<i>Catananche lutea</i>	<i>Medicago aculeata</i>	<i>Trifolium angustifolium</i>
<i>Centaureum spicatum</i>	<i>Medicago murex</i>	<i>Trifolium repens</i>

farmers' own riverside land, which could usually be altered to be of low enough level for *Arundo*.

- (f) Remove trees and large shrubs whenever these create an obstruction to flood in the bed.
- (g) At least once in two years, remove fallen branches etc., from the watercourse. (This presupposes (a) above is accomplished.)

Encourage Valley Stability

- (a) Plant trees and shrubs where they will stabilise banks (see Chapter 16, and (f) in previous section above).
- (b) Encourage other appropriate vegetation on fragile banks (see Chapter 16).
- (c) Repair retaining walls. (These are constructed by landowners or Government (the Government also acts on behalf of church property). Maintenance is usually by tenants, under the tenancy agreement (see, however, Chapter 15).
- (d) Stop snail picking where this dislodges stones. (Farmers sometimes discourage collectors by signs indicating pesticide use.)
- (e) Stop any other bank activities which erode banks. This includes: inappropriate climbing, abseiling, off-roading or walking etc., and anything else that disturbs the texture of the bank, valley, gorge, or cliff.
- (f) Stop valley floor activities which disrupt soft, relatively deep soil (e.g. off-roading, dredging) and digging holes (sumps) to remove water.
- (g) Repair or remove dilapidated dams.
- (h) Stop valley activities which wear away the protective covering to the valley floor or sides, either the natural vegetation or the stone cover, which leave bare earth unstable in flood.
- (i) Regularly remove accumulated silt above dams so these can still collect their design flood flow water (see Chapter 16).

Decrease Flash Floods in Built-up Areas

Flash floods happen when rainwater is unable to percolate down into the soil.

Study storm flows, the pattern of run-off along streets (above and below ground), its sources, destinations and obstructions. Alter the flow pattern as appropriate (and clean the water, see below).

Decrease Flood Damage in Rural Areas

Storms bring heavy rain. Heavy rain will find a passage downhill. If a non-hazardous passage is not provided, the storm water will make a flow path, usually taking top soil and breaking walls etc., on its way.

Study valley slopes and walls, and create safer storm water paths to wadies.

Decrease Pollution of Field and Aquifer

Polluted aquifers mean polluted drinking water. Polluted fields mean polluted fruit and vegetables.

Polluted water entering the sea decreases fish and other populations and causes major as well as trivial diseases to those bathing and paddling.

Polluted water in the wadies causes all of these by percolating down into the aquifer, by being re-used on the fields, and by reaching the sea.

- a) Never allow spilled liquids to leave the roads. Spills inevitably happen, from accidents to lorries, farm vehicles etc., even carelessness while changing car oil. Absorbent mats or granules should be used (e.g. the ones produced by Unisafe Rescue Tools, Scotland). These absorb all the liquid, are bagged up and taken to toxic (or ordinary, as appropriate) waste disposal facilities. It is important to remember **all** liquids except clean water should be disposed of like this. A lorry load of milk, for instance, though highly beneficial when drunk, is seriously polluting anywhere else (it has a high organic content, just like sewage). Liquids used in putting out fires must be dealt with in this way too; and promptly, once the fire is out, since large quantities are involved. Spilled liquids leaving the road will go to valleys (so to aquifer, field, or sea) or direct to the sea.
- (b) Prevent effluent from factory, farm or garage etc., leaving those premises (except to proper treatment works). While few concerned will so pollute once they know the dangers, some will (one classic example being the owner of a factory in the USA who let out his week's supply of industrial effluent between 10 and 11 a.m. on Sunday morning, when the community was at church).
- (c) Prevent run-off passing over scrap metal or other polluting material from riverside industry from reaching the river. The best way is to

ensure no polluting material is left in the open to be rained on! The other is to direct the run-off water to the sewer for treatment in sewage treatment works (unless proper studies show the chemicals concerned will be disposed of by (d) below). Such scrapyards are increasing in valleys (e.g. (Qormi, Kalkara, Zejtun etc.)

- (d) Clean the run-off from well-used roads before it enters wadies (or the sea, for that matter). This means:
 - (i) numerous sediment traps, all regularly cleaned out;
 - (ii) channels for run-off water which are open to the air and, where possible, vegetated for some distance before the water-course is reached.

Where the traffic is such that these methods are inadequate (as main urban and country roads) the water must be diverted to the sewage works. Flows must be studied in relation to the present sewers and remedies be applied if these cannot carry the water.

- (e) Remove rubbish from wadies (see Chapter 7).
- (f) Prevent petrol or oil loss from vehicles in wadies.
- (g) Study the pattern of fertiliser addition, and decrease the quantity leached out of the soil without benefiting the crop (e.g. altering the type of application, such as using slow release granules). Prevent used containers being thrown away, (unless thoroughly washed, they still contain chemicals), and over-feeding, but increase the use of organic farming.
- (h) Decrease biocides similarly. Introducing Integrated Crop Management techniques improves pest control while using much less chemical.
- (i) Maintain existing buffer strips (see Chapter 7) and insert new ones in those riverside areas described in the next section (Monitor Pollution of Wadies, Field and Aquifer) as being particularly at risk from agrochemicals.

Monitor Pollution of Wadies, Field and Aquifer

Pollution never stops, and is expensive to control. Monitoring ensures the best use of resources. Monitoring is very expensive, and so are the remedial measures when pollutants are found to be at hazardous concentrations. EU accession would make it necessary, and the money would be found. Since Malta shows, in an extreme form, many troubles found elsewhere in Europe, a research study might be of much benefit to all the southern EU countries.

- (a) Chemical analysis is needed on a monthly basis from a variety of wadies, for: agrochemicals (fertilisers and biocides), organic contamination (Biological Oxygen Demand, ammonia, chloride etc.), road run-off chemicals (including heavy metals, hydrocarbons etc., known to be both pervasive and damaging (e.g. benzene group, toxaphene, DDE), a few of the pollutants expected from livestock units or in foods, etc., substances likely to come from farms etc. (e.g. steroids) and any other pollutants known to be emitted locally in significant quantities. The biocides analysed should include a range of those used in Malta (mobile and non-mobile, those with fast and slow breakdown).

Testing is needed for the top soil of wadies, and, in the wet season, also of water both from impoundments and from free-flowing reaches. Farmers and growers should be made aware of the dangers of irrigating with contaminated water. The sites should be selected for high and low pollution from run-off, farms and industry, and should include places where most water seeps to the aquifer, places with perennial spring water, and ones entirely rain-fed.

- b) The same chemical analyses are needed of soils irrigated by valley waters, selecting sites given dirtier and cleaner impoundment water, and much and little impoundment water. Places irrigated by the southern partly-treated sewage effluent should also be tested. They should also include fields bearing a range of crops, below-ground ones (e.g. potatoes, carrots), leaf ones (e.g. cabbage, lettuce), grains (e.g. wheat, barley), herbaceous fruit (e.g. tomatoes, strawberries), woody plant fruits (e.g. olive, peach, citrus) and forage crops (e.g. sulla, green barley). Three analyses a year may be sufficient to start with. Once a pattern has emerged, if this is stable, less testing may be acceptable.
-) The same chemical analyses, on the fruit and vegetables grown in the fields chosen for (b) above. Tests should be done on the harvested crops.
-) Analyse, for the same chemicals, spring water from the gneiss lines from places of expected low and high pollution.
-) Similarly analyse other spring waters.

Records of sampling (how, when and where) and analyses, should be kept and studied.

Study Pollutant Breakdown in this Mediterranean Soil

A proper study of pollutant breakdown in Malta's soil has not yet been carried out (see Chapter 7).

Use the Valleys to Clean Polluted Air from Settlements and Roads

Microbes on leaves break down many organic poisons (see Chapter 7), such as some in petrol fumes. Leaves take up, to turn into plant material, the carbon dioxide breathed out by people, animals — and motor vehicles. A hundred large trees (of San Anton Garden size) take 18 tons of carbon dioxide out of the air each year. Tree lines along busy roads remove 90% of particles and much of many other pollutants. With so much of Malta going under concrete, which does nothing to clean the air, it is increasingly important to keep the valleys clean, and to encourage more large plants to grow. The more leaves, the more cleaning. Trees are therefore best, then shrubs, then tall herbs. These should be on the valley slopes, in breaks in cliff faces, on walls, in some of the fields, and as low down in the valleys as does not create flood hazards. (Nature conservation requirements should be considered also, see Chapter 16.)

15

REMEDIAL: TO CONSERVE THE CULTURAL HERITAGE

Constructions and other Artefacts of Ancient and Recent Days

Investigate constructions and other artefacts of interest, including their significance, representativeness, prominence, uniqueness or just great age.

- (a) List the constructions and their locations. These include:
- | | |
|-------------------------------------|--------------------------------------|
| abstraction structures | old water level markers |
| archaeological structures | old water width markers |
| bridges | pipes |
| cart-ruts | reservoirs |
| caves | river-worn stone |
| channels mobile after straightening | roads, footpaths, tracks |
| chapels | shrines and statues |
| dams | small tributaries (walled or narrow) |
| dug banks | straightened channels |
| dug channels | walls (see below) |
| houses and corbelled huts | water channels (especially old) |
| | military buildings/installations |
- ... and many more!
- (b) Discover history, dates, uses, legends, and people associated with these, as available and appropriate.
- (c) Write these up, as a short reference version ("to be preserved, for these reasons") and a full version for the interest and guidance of Local Councils, Government Departments and visitors.
- (d) Produce short leaflets for visitors about specific widien or parts of widien.

Remedial: To Conserve the Cultural Heritage

- (e) Put up appropriate plaques on features of special interest (vandalism must be considered here).
- (f) Give educational talks to schools and other groups (e.g. church, voluntary). Escort those interested, on tours and field trips.
- (g) have wardens at the most interesting sites (starting with weekend volunteers) to give talks and tours as well as to prevent vandalism. Sales of guides, pictures etc., might help towards funding paid wardens later. These can be combined with information on Natural Heritage, see Chapter 16.

List and Publicise Actions

List, carry out and as relevant publicise (as in (c) to (g) above) actions to be avoided, remedies to be supplied.

(Follow Appendix 1 before applying remedies)

- (a) Remove rubble and rubbish and then prohibit its dumping. Rubbish attracts rubbish. There should be regular clearing of visitor-attractive sites, as well as frequently emptied (and attractive looking) refuse bins. (These bins should be too small to attract business rubbish.) Removing rubbish without damaging soil or plants is a skilled job. It should usually be done by hand, and with care on where the people and skips are placed, and how they move. Expert advice is always advisable, and is necessary if mechanical removal (bulldozer, etc.) is being considered. It is rarely that mechanical removal can be recommended.
- (b) Remove unsightly objects blocking scenic views, e.g. mounds of river-side rubble, some unused (recent) buildings.
- (c) Stop concreting, asphaltting or other surfacing of tracks in water-courses (for non-recreation purposes). Remove some of the existing new roads built on ugly infilling rubble. Re-colour white ones to make them unobtrusive (tarmac?).
- (d) Create and maintain a few footpaths or narrow roads (altering from (c) above), ones which visitors find pleasant to use, and so will use rather than walking on, and so damaging a wide extent of valley floor. (The Chadwick Lakes road is an excellent example.) These need careful selection and design.
- (e) Create and maintain car parks and picnic sites where these do no damage but provide much pleasure. Abandoned land is an obvious choice.



Fig. 15.1
Types of stone wall. Left
and facing page.

Note the variation in
the dry (stone) walls,
and the more standard-
ised modern types.



- (f) **Never** wilfully pull down a wall, building, water channel, or move existing stones to e.g. fill in road pot-holes, unless Appendix 1 procedures have been gone through and it is certain no damage to cultural artefacts will result. (There is plenty of dumped stone in Malta to fill any amount of holes without pulling down a unique bridge!)
- (g) Stop all activities likely to destroy or harm the cultural heritage, e.g. quarries, removal or disturbance of bed or bank, rubble, dust, vibrations, off-roading, abseiling, climbing and the others listed in Chapters 10 and 11. Where river beds have been lost in quarries, new and (fairly) impermeable ones should be constructed (ones which are already, or

Fig. 15.1 (cont.)



Right. Note the gaps left
for run-off to pass safely
through (compare Fig.
6.9).



are capable of becoming, of varied architecture and texture). No quarry rejects, including dust, should reach valleys. Streams should rarely, if ever, be put underground. Instead, bad pollution should not reach them and they should be made town ornaments and focal points of interest. Watercourses should never be completely lined in the way the Sewda was recently lined in Qormi. Town dwellers are right to complain about ugliness and smells, but the remedy is to have a clean and beautiful watercourse, not an ugly nondescript uniform bit of tarmac. (*Bouganvillea*, growing on netting above, is one pleasing solution where flow is intermittent: and is cheaper than tarmac.)

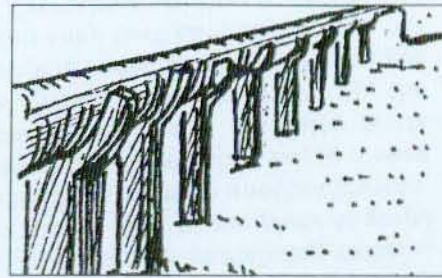
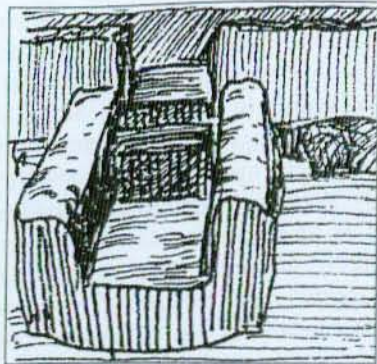
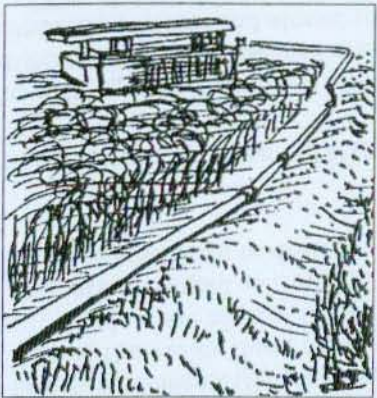


Fig. 15.2
Water channels, (a,b,c Haslam, 1991a).

- (a) Left top. Traditional on ground.
(b) Above. Traditional, on stilts (supports) over ground.
(c) Left bottom. Channel replaced by pipe, recently.



(h) Care of walls. Malta is blessed with a wide variety of types of traditional dry walls (Fig. 15.1). They differ in construction with age and place. Repairs should be kept regular, and with the same construction. (Some are not!) If a new wall is needed, or an old one needs to be repaired, it should be built like its predecessor.

Volunteers, even if not Government employees, should learn from those who, in different parts of the Island, build and repair proper dry walls, so that there is a constant supply of people willing and able to maintain this very important part of the cultural landscape of Malta. Modern (wet concrete and oblong stone) walls are for towns, and for the country only if it is not possible to use dry walls.

- (i) Care of water channels (Fig. 15.2). These range from Roman to recent. Old ones, however disused, should be retained, and maintained in the traditional way (see (h) above).
(j) Care for the ancient bridges. These also should be kept, and repaired in their existing style (Fig. 6.7(c) shows a multitude of dates; interesting, but not the best type of interest!).

Fig. 15.2 (cont.)

(d) Recent concrete at edge of field.



(e) Recent concrete, collecting from upstream, leading to tank below.



Care for Visitors

Large numbers of uncontrolled visitors unintentionally destroy the very objects they come to see, by sheer pressure of numbers (quite apart from any vandalism). Therefore care is needed, but care in such a way that it pleases the visitors as much as the conservationists. The Chadwick Lakes road has already been cited. Narrow, well in the channel, it gives the full "feel" of being in the Lakes to both walkers and vehicles, and being narrow,

prevents the latter being a nuisance to the former. Being easy to walk on, most visitors stay on the road, and do little damage anywhere else.

The solution for each situation is different, but all comprise: safety of the valuable parts of the site; pleasure to the visitors.

A car park can be unseen from the wied, and have a clearly-marked trail leading from it. Spiny plants, low dry walls and ditches can all be enhancements which also control movement. Trail signs, frequent and clear, mean few people try other directions. Valuable and fascinating rocks or artefacts can be removed to a museum, copies fixed in place and, if desirable, small objects can be covered with waterproof perspex. Wardens, talking with authority about things of interest to visitors, guide them in the way they should go (in both senses of the phrase). Dry walls, low enough to look over, with plaques, can encourage looking at, not touching, valuable objects e.g. trees.

Picnic places should be enjoyable to sit in, with attractive benches, tables, and scenically pleasing litter bins. If the places are nicer to sit in than is the valley floor, people will use them.

Vandals are always with us, but their number will be much reduced if sites are arranged so that the potential vandals find it more enjoyable to be interested than to destroy.

Maintain "Sense of Place"

In such a managed land as Malta, much of the "Sense of Place" comes from differences in land use and management (often continued over decades or centuries), trivial and almost unnoticed differences, as well as major ones.

The object of conservation is not to stop management (which would not conserve, as management has created that which is to be conserved). Its object is to conserve wisely, to discover, by observation, by discussion with those managing the land, and by examining records, what differences exist and to preserve them. Why is one piece of gorge different to another (Ghasel, Qirda), one flat stream to another (Sewda, Țleghja)? What made those differences and how can they be, in a very different social world, retained? One of the glories of Malta is its heritage of variety in "Sense of Place". When plans are drawn up, the first consideration should be what each wied used to be like. If changes are necessary (e.g. new roads), how can they best have minimum, not just scenic, but cultural disturbance? Everything tending to uniformity

should be excluded: modern (wet-concrete) walls, lines of trees (particularly exotic), unvarying field shape, unvarying crop patterns (insofar as this is consistent with good farming practice) and repetitive buildings. The separate identity of each wied — the importance and interest of which has been repeatedly stressed in this book — should always be given high priority.

Provide Compensation

It is unreasonable and wrong for landowners and tenants to be expected to forego income because their land by chance contains special cultural or natural heritage.

This problem can be solved by:

- charging entrance fees, where the interest of the site and number of visitors justify this;
- receiving the amount of income or profit lost by the conservation from the Government;
- receiving the same from a charitable organisation (whether enlarged existing ones already set up to benefit Malta, or ones newly set up for the purpose. Giving money to benefit Malta should be more widespread, and education is necessary).
- developing sound ecotourism.

REMEDIAL: TO CONSERVE AND ENHANCE THE NATURAL HERITAGE

With good management and human commitment, nature often takes over and heals itself.

René Dubois

The historic heritage does not need enhancing, a bridge either is or is not there, is or is not in need of (proper) repair and can or cannot be seen properly by those interested. Conservation here is just preserving. The natural heritage needs active measures to enhance, to partly restore to what used to be there. Conservation is here a dynamic process, to care for as well as to preserve. We try to return to, as far as is possible in this very different world, the flora and fauna moulded by many centuries of land management, of sustainable use, of interdependence between people and the land. This interdependence is now largely lost, when any food can be imported at any season, so no land actually needs to be farmed, and construction and pollution are the most important elements of life. It is impossible, as always, to return to the past. It is possible, though, using ecological wisdom, to restore some parts of wieden to something closer to what they were between, say, 1750 and 1880 than they are at present.

Improve Water Quantity and Flow

- a) Increase the flow of (the cleaner) run-off water to wieden, by studying and altering run-off channels to take (this cleaner) water there, rather than via roads and drainage systems to the sea (and see "Improve Water Quality" below).

Remedial: To Conserve and Enhance the Natural Heritage

- (b) Increase the spring water running to the wieden by (i) compensating farmers for the loss of some of this water (in selected wieden) and substituting reverse osmosis water, and (ii) encouraging drip irrigation, which conserves water supplies better.

Spring water runs for more of the year than rain water and runs more steadily (see Chapter 2). Consequently the flora and fauna of spring water differ to that found in stagnant impoundments.

- (c) Allow only the officially permitted amount of ground and spring water to be extracted, and gradually decrease these quantities in favour of reverse osmosis water. This could be done if all boreholes and springs are metered.
- d) Study the use of impoundment water. Of course this water is for irrigation, but too many impoundments have the worst possible pattern for aquatic life: being filled completely and emptied completely. Study of impoundments over the length of a wieden might discover another pattern, which could keep water levels more stable (and with a more gradual drop in spring) and which could be implemented without detriment to the farmers. Since the first large dams were put in only in the 1890s, and most later, there is no farming heritage tradition to be preserved. The Rihana and (Gozitan) Sara rivers have a flow of water between impoundments most of the wet season. The causes for this should be found (more incoming spring water, less loss through the bed), and, if possible, other wieden should be altered to be the same. The Rihana has the most aquatic vegetation of any Malta rivers.

Improve Water Quality

- (a) Stop farm, house, factory and other effluent reaching the wieden.
- (b) By means of silt traps and open channels, vegetated where possible, clean middle-grade road run-off so that it is suitable to enter wieden.
- (c) Divert bad-grade road etc run-off to sewers.
Note: the expense of these is justified by the advantage to the Water Services Corporation in decreasing aquifer pollution.
- (d) Clean the spring water by wiser use of fertilisers, low in-pot organic farming and Integrated Crop Management (see Chapter 14) to prevent the leaching of unused chemicals from the fields. This would return the wieden water, which is so important for natural stream sources as well

as for farming, closer to its original composition. It would therefore be more likely to bear its original plants and animals, rather than polluted communities. At present the gnien water is badly contaminated by agrochemicals in some areas. The deeper-rising springs have longer retention times for waters, and it could be even a few decades more before the full contamination from recent pollution reaches them. A longer retention time also means a longer clean-up time. Clean gnien spring water is higher in calcium and lower in other solutes than the deep *Globigerina* etc springs. The proportions of the waters (gnien spring, deep spring and run-off) therefore govern the communities, where water is clean. Pollution adds a third, and often overriding-source of chemicals (e.g. an English low-solute limestone spring had *Berula erecta*, *Mentha aquatica* with increasing solutes *Ranunculus* spp. then *Callitriche* spp. *Nasturtium officinale* and others. Increasing pollutants in that habitat decreases these species and increases Blanket weed. The names are irrelevant. That the names change, is the important point).

- (e) Insert buffer strips to clean incoming water carrying diffuse-source pollution (see Chapters 7 and 14).

Careful Dredging (see Chapters 10 and 15)

For conservation, there should be frequent removal of small quantities of silt in impoundments (and anywhere else where sediment accumulates), so smothering quantities are never found. The hard bed below should not be broken. It contains propagules, and should be left for re-colonisation. If there are compelling reasons for breaking the bed, the dredging should be spread over several years, so plants and animals can move and colonise the new soil before being removed from the old. For this, proper dredging practice should be explained to farmers and contractors, and farmers should perhaps be compensated for the extra work involved.

Bed Structure (Fig. 16.1)

- Remove rubble, rubbish and other dumping.
- Stop disrupting soil by e.g. off-roading, excessive visitors, dredging.
- Maintain the natural bed and its natural variability. In a good place (e.g. Chadwick Lakes between impoundments), there may be gravel,

Fig. 16.1
Variation in bed and vegetation types, Chadwick Lakes, Wied Qlejgha, Ghasel, before pollution started in 1995.

(a) Partly stony, more soil low disturbance; has been flooded for several weeks.



soil, mixed-stones, rock, etc. and all found at different levels, so covered with water for different durations. (The duration of flooding also varies from year to year.) This variation of texture and water regime gives a great variety of plant (and animal) communities, much aquatic marsh and land flora, varying with rainfall and water management as well as with season. This diversity can be contrasted with the uniform monodominance of *Alisma plantago-aquatica* in the uniform silted-up dams.

Bank Structure (by the Watercourse Bed) (Fig. 16.2)

Malta is almost without natural river banks. Nearly all banks are man-made (walled, dug) or man-altered. To improve:

- remove rubble, rubbish, etc. (see Chapter 15);
- if possible, remove rubble recently used to infill valleys;
- stop recreational and other activities which harm retaining walls and other banks;
- preserve and maintain the remaining good banks (Fig. 1.3);
- where breaches in retaining walls are present, these should be repaired (where possible) in keeping with the original technique.



Fig. 16.1 (cont.)

(b) Soil with some stones, low disturbance.



(c) As (b) but with more disturbance.

Banks may be walled, be steep or vertical (clayey earth), or dug (e.g. 1.5:1) or be rock etc. Gorges, and a few other places (such as in Fig. 16.2) have banks worthy of emulation. Much enhancement can be done in ugly or ecologically unsatisfactory places (see Chapter 3) to increase greenery, diversity of vegetation, and diversity of texture on the banks. When creating new banks, it should be remembered that there is only a little soil. Soil texture as well as engineering determine slope. Disturbing soil increases nutrient status and ruderal plant and animal species. Trees help stabilise banks and soil.

Fig. 16.2 (a,b,c,d)

Bank types for emulation. All are man-made, but show satisfactory features of vegetation and variation, and of slope or soil texture.



Valley Structure **(Wide Vales, Steep Valleys, and Gorges)**

- (a) Stop damaging activities, dumping, stop construction of roads and buildings on Areas of Outstanding Natural Beauty, etc.
- (b) Repair (properly, see Chapter 15) retaining walls and other dilapidated landscape features.
- (c) Allow wild vegetation to grow on as much ground as is reasonably possible: gien areas, steep slopes, valley floors.



- (d) Keep grazing at a controlled low level, to allow plants to grow (see (c) above).
- (e) Maintain old fields and patterns as far as is consistent with good yields.
- (f) Decrease pollution to the river bed and aquifer (see Chapter 14).

g) In quarried areas, buttressing with rubble walls along former contours and elevations (where possible) to screen off quarry damage and allow some growth of native vegetation.

Planting Trees

Trees provide:

- (a) clean air (Chapter 14), by taking up carbon dioxide, and by breaking down organic pollutants etc. through the microbes living on their leaves and other plant parts;
- (b) habitats for invertebrates, reptiles, birds, mammals and other animals and microbes etc;
- (c) habitats for lichens, mosses and other tree-growing plants;
- (d) habitat variety on the ground (e.g. shade, part-shade and sunlit, so giving plant and animal communities adapted to all those habitats);
- (e) habit variety, tall and short, conifer and summer-green, dark and pale, wide and thin, etc;
- (f) landscape variety;
- (g) an excellent way to prevent soil erosion;
- (h) scenic value and beauty.

Because originally Malta was wooded with evergreen oak (*Quercus ilex*), Aleppo pine (*Pinus halepensis*) etc. (Chapter 1), and olive *Olea europea*, and soft-fruit trees have been traditionally cultivated in the Island (Chapter 4), increasing Malta's trees and woods is restoring earlier vegetation. Monocultures, though, should be avoided.

Trees added in the countryside, however, must be native or so long cultivated that they count as native (like carob and olive; quite likely native but not provably so). Exotics like eucalypt, bougainvillea, acacia and palms are proper for towns and for urban areas. They beautify these areas. In the country, planting should be of native trees, both for good conservation practice for the tree itself, and for the habitat created by that tree. Trees are homes for myriads of insects, and other small animals and plants on which larger animals feed and grow. The communities have evolved together with the trees. Alien trees differ in chemistry (and sometimes structure) and the fauna is much impoverished, as many Maltese insects do not tolerate the chemistry of, say, Australian trees. Eucalypts, in particular, contain antiseptic oils (which is why Oil of Eucalyptus is used in many effective cold and flu remedies). Antiseptics kill bacteria: so kill bacteria found on Malta trees. Therefore rural eucalypts and other exotics should gradually be replaced, however pretty these, especially acacias, often are.

Exotic strains of native species are quite as bad. They bring in alien genes. They interbreed with the native trees and so alter the native gene pool (which is even worse than what happens with exotic species).

Importance of Native Trees

The small size of Malta means native gene pools can too easily be altered. Only if native strains are proved to be suffering from lack of native diversity should there be imports. This danger has only recently been understood. In the 1970s, when Malta was so devoid of trees that any were thought better than none, non-native stock was imported. Now, however, Malta can produce its own trees from local stock, and this is the proper procedure to protect biodiversity. Alien strains may have different behaviours (e.g. leafing and flowering at times unsuitable to the Malta climate) or look different (e.g. have leaves at different angles). Either way, Maltese species should remain Maltese. Indeed Maltese strains should remain Maltese strains. Where possible, local material should be used: Girgenti seeds for Girgenti planting, Qannotta seeds for Qannotta planting and so on.

Variety is to be aimed for: groves, clumps, lines and single trees and indeed no trees at all, are all desirable. A variety of species, planted either alone or mixed is desirable. They are desirable both scenically and for habitat diversity. The same applies along stream banks. Short stretches can have trees planted close together on both sides, others can have trees on one side, and elsewhere there can be scattered trees or an open vista. Fields, if abandoned, may be transformed to groves or orchards, and olives can be encouraged in suitable places. Carob and prickly pear can be planted along walls, and prickly pear can be used instead of walls. Trees should be, though, on some, not on all walls. The pictures of e.g. Wied Babu (Fig. 13.2) can be studied for the effect of mixed woody plants creating a habitat which is good scenically, locally, and faunally, and for keeping (most) visitors to designated trails. However, in all plans for woody plants, "Sense of Place" must be considered. Trees planted should be of species already there or known e.g. by place name evidence) to have been there in the past. Trees may need protection from trampling and grazing when young (Fig. 11.6). Sheep and goats like young saplings, and, by eating, kill them: this is one reason for the little natural tree regeneration. Oil drums are often used. Barbed wire or netting are often less obtrusive.

Planting Shrubs

The principles are as for trees (above), except that some shrubs can grow with less soil and more exposure than can local tree species. (Other shrubs,

of course, need deep soil, shelter and a good water supply.) Briar (*Rubus ulmifolius*) are good stabilisers of dredged banks, and usually grow well in wadies, particularly with a little disturbance. Shrubs are one of the components of the multi-layered Mediterranean woodland.

Planting and Encouraging Shorter Land Plants (from Seeds or as Grown Plants)

The principles remain the same as for woody plants, except that added species must not be ruderal ones, but those present in stable, traditional communities. Management (including controlled light grazing, heavy grazing, absence of grazing, cutting, stopping disturbance) may be needed to produce and sustain different communities (soil should usually be kept undisturbed). There are too many possibilities to discuss here: it is a matter for expert advice.

Encouraging and Planting Marsh and Water Plants

The same principles of diversity, native communities etc, apply here also. As aquatics disperse well, if a suitable habitat is created, it is usually occupied within a few years. If not, it should first be checked for its suitability, and only then be planted. It is important to provide as much aquatic and marsh habitat as possible, and keep it suitable by avoiding (for conservation) over-deep water, pollution and the damaging activities described in Chapters 10 and 11. To have a varied habitat is also important: varied in water regime, soil type, management pattern, etc (see Fig. 16.1).

Control and Partly Remove *Arundo donax*

Arundo grows best in places which are winter-damp, extending between those ephemerally flooded and those with water well below ground level (though with accessible water). It is, in parts, a valued crop for home and tourist artefacts (screens, beach umbrellas etc), fencing, general screening, farm litter etc. *Arundo*, like carob, is not provably native, though is within

its native range. It forms monodominant populations so tall that most or all other plants are shaded out — and grows where the now few and rare native marsh populations can grow. The fauna is likewise restricted, since invertebrates have only one species to feed on. As one species among many, *Arundo* is desirable. As a blanket over damp places it is undesirable and should be lifted and destroyed or limited to small clumps. Any extra wanted by farmers should be planted in new riverside habitats (see Compensation, Chapter 15).

The main habitats of *Arundo* are:

1. small steep watercourses, where it grows in winter-damp beds and on the banks of winter-wet channels. *Arundo* marks out such places on hillsides. Here it is no flood hazard, and when patchy, as is usual, is no conservation danger. However, if *Arundo* covers most of the damp habitat, most should be removed;
2. on the banks of wetter larger watercourses. If *Arundo* grows in scattered clumps, this is quite satisfactory. If it dominates, it should be removed as in (1) above;
3. on the bottoms of rather damp main watercourses (those neither much flooded nor greatly dried). Again, scattered clumps can be left (though monitored every few years), but *Arundo* dominating, whether over short stretches, or over several km (e.g. Luq), is a flood hazard unless a road beside can act as a flood relief channel) and must be reduced for that reason as well as for conservation.

The Do Nothing Option

Before taking action, the consequences of doing nothing should always be considered. If habitat is adequate or better than adequate, at this stage in Malta, do not interfere. There are plenty of places where habitat is awful, where practically nothing can make it worse, and these can well be used for experimental design. When a body of expertise is built up, rather better habitats can be enhanced, with the knowledge of what will result in a decade or two. Only after that should satisfactory habitat be enhanced! Of course, when doing nothing means damage will result (more dumping, off-roading, climbing, abseiling, dominant *Arundo* etc.), then action is always needed.

Nature Trails etc. (and see relevant parts of Chapter 15 and Appendix 1)

Nature trails would, of course, be combined with historic heritage trails: combining the tree, the duckweed (*Lemna minor*) and the chapel.

Nature trails should describe the wided features, its shape, structure etc; and where the vegetation is cultivated and where it is not, and why. On cultivated ground should be noted:

- the type of crop (in general terms, so that the crop patterns of next year do not contradict this year's descriptions);
- whether land is abandoned;
- the soil type and colour;
- the field shape
- the wall types and their positions.

What is the water regime? on irrigated land how is water delivered? By water channel (Fig. 16.3)? If so, recent concrete, older stone or ancient Roman? By pipe? If so, laid permanently and

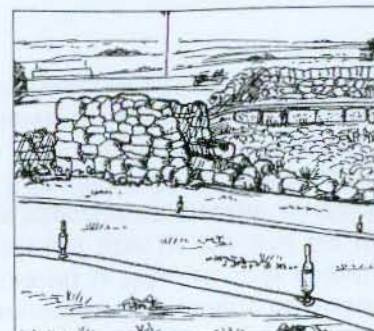


Fig. 16.3
Irrigation by sprinkler (Haslam 1991).

largely underground with spray nozzles arranged over the field, by loose hose pipes, or by drip system? What are the different advantages of tradition and convenience? Does the water come from springs, wells, impoundments, boreholes, rain-fed cisterns, or sewage treatment plants?

In uncultivated parts, what are the vegetation types? First scenically, then vegetationally. What is traditional, what ruderal, and why? Then the watercourse, what are the banks like? What are the vegetation types? What is of interest about these? Are there ruderals? If so, why has that occurred: disturbance, dredging, digging? How are the banks — if any — kept stable?

In the bed, what water regimes are expected, winter and summer? What vegetation, where and why?

All these, properly presented, are of much interest to visitors, and help them understand, and so appreciate the widden.

The topics covered would vary with the features of the wided, and the interests of the people concerned. One trail might describe only historic and present water supply and discuss water resources. Another might describe chapels, land forms, vegetation, or future developments. There can also be fuller trails covering all these, and more.

APPENDIX 1

WHAT NEEDS TO BE DONE, AND HOW TO DO IT

The sobering prospect is that most of the major public decisions about resource use and environmental management will be made in the face of large uncertainty derived from ignorance of physical and biological systems and from evolving techniques and social values.

G. White (1980)

That Which Needs to be Done

The material that follows is drawn from the Food and Agriculture Organisation of the United Nations, 1993, EPA NPS News-Notes of the United States, 1993, and Malta Environmental Law (as well as from the writers' experience).

This book has shown clearly enough that much of Malta's river valleys are in a deplorable state, are deteriorating with extreme and unpleasant rapidity, and that action should be taken **now**. Malta is not of course the only country with rapid destruction, but its small size makes it exceptionally, perhaps uniquely, vulnerable. Dig over a mile of river in France or put the water underground. A great pity, to be sure, but it is only one of many thousands of miles of river, and the proportional loss is small. Do the same (with a quarry) in Malta. The loss is of one out of only about sixty such miles, and almost certainly it is the loss of the only example of that kind of valley. Malta's widien are exceptionally, perhaps uniquely variable: the diversity of river types is quite extraordinary.

Anyone who has read this book will recognise the need to do something, and fast. But what of those who have not?

There are a lot of regulations that are flouted with the connivance of the officials who are supposed to enforce them. Regulations have to be publicly accepted if they are to work. There

aren't enough policemen to go round imposing unwanted regulations.

Land use planning is as much a matter of public education as of land-use zoning (specification) and regulation.

To simplify, while it is socially acceptable for rubble to be dumped in valleys, it will be dumped. Those objecting are just yapping and being silly. Once the reasons against such dumping are socially known, and socially accepted, very little indeed will be dumped. What law and regulation affects widien? The beds are generally (not entirely) owned by the Government and (technically) administered by the Lands Department. The banks and valley sides may be Government or private property. The Water Services Corporation has the right to dictate water flow, and part of the duty to ensure water cleanliness, though that also comes under the Sewage section of the Ministry for the Environment's Department (for sewage), the Agriculture Department (for farm pollution) and the Police, with large polluting objects reaching the sea coming under the jurisdiction of the Maritime Squadron of the Armed Forces. Local Councils have involvement also. To add to the confusion a separate (1993) law prohibits collecting animals including frogs and reptiles, while hunting and trapping regulations are frequently changed.

These last receive publicity, though little compliance. What of the rest? How many people know that parts of widien are Government property? Not even the Government itself knows which! To summon officials of four separate Departments to attend to a pollution is a waste of time and money to the three who are not responsible for it. Surely a single Pollution Inspectorate, accessible to Local Councils and the public, would be better? What about public access? Government land has it (unless that right has been let), private land has access only by the favour of the landowners. Where is which?

At present, anyone coming to a valley to picnic, collect frogs or ride a horse or motorcycle cannot know whether this is legal or not: where there is no knowledge of law, why should anyone refrain?

The Objectives

The Country.

do work so that in years to come, no one can tell work has been done.

Historic features are in good repair — from chapels to rubble walls, there are no modern (uniform) walls etc. to be seen. For natural heritage there is diversity of bed and bank and a natural type diversity can be very carefully continued to fit with money available for other purposes (such as water resources). Native vegetation — and so animals — are growing well wherever it is safe for them to do so. Disturbed soil has over-high nutrients and so it may be decades before such vegetation develops. There should be no dumped rubbish or damage by off-roading etc.

2. The Town.

To do work so that, in years to come, people will say, "How beautiful that is!"

Recommendations (1-7)

Recommendation 1

Read Chapters 10, 11, 14, 15 and 16 of this book before starting.

Recommendation 2

A leaflet to be produced by the Department of Information (with the help of the Planning Authority) stating clearly:

- (a) land owned by Government (with maps);
- (b) the parts of this which the public may enter and a list of welcomed and of prohibited activities;
- (c) land owned privately (with maps);
- (d) the parts of this which the public may enter, and the activities which are permitted;
- (e) the functions of the various government, council and voluntary organisations in relation to:
 - maintenance of historic features,
 - maintenance of riverscape and landscape features,
 - conservation of plants and animals,
 - creation and preservation of public amenities,
 - protection of underground water table, for the quantity of water reaching it,
 - protection of underground water table, for the quality of water reaching it,

- protection of surface water, for its quantity,
 - protection of surface water, for its quality,
 - wardens;
- (f) the addresses and telephone numbers of all relevant organisations, and the landowners permitting access.

Recommendation 3

That this book be easily available.

Recommendation 4

That talks should be given on a wide range of local level, using material in or equivalent to that found in this book, talks that are user-friendly and have plenty of colour pictures. It is essential for these to be taken to the public, not that the public be expected to attend them at inconvenience. They should be held both where and when people already gather together, e.g. church groups, women's groups, Local Council meetings, Guide and Scout groups. What about 10-minute talks at (some) places of entertainment? A programme on television would be a valuable introduction.

These recommendations are for the beginning of public education, and so awareness. Only a few bad people do that which they know to be wrong. A whole population can destroy irreplaceable heritage with no knowledge or intention of doing anything amiss.

Until very recently there was nothing wrong in lack of awareness. In a traditional society, all knew from their parents and grandparents what should be done and what should not. The reasons might be lost in the mists of time, but traditional practices were traditional just because (in stable other conditions) they were sustainable. It is the violent social change of recent decades which has produced practices not known to earlier generations, like dumping rubble, using chemicals and losing river water, and which has made awareness and land use planning essential if Malta's heritage is to remain.

With greater public enlightenment the reasons for Environmental Impact Assessments, before major projects are undertaken, can be better appreciated. These are required by an Act of 1991, explained in a Ministry of Environment 1992 document. There are two grades: the fuller, more detailed and higher level "Environmental Impact Assessment"; and the more sketchy and lower-level "Environmental Impact Statement".

Factors to be considered for an Environmental Impact Statement are:

- a) physical features;
 - population, settlements, work places (proximity and numbers);
 - flora and fauna (both habitats and species). (Species in the Red data Book, Schembri & Sultana 1989, require special protection.);
 - soil, agricultural quality, farm size and structure;
 - geology (rocks), palaeontology (fossils) and geomorphology (land forms);
 - water, and hydrological features such as watercourses, aquifers and existing discharge in relation to water type, quantity, composition and strength;
- (g) air, including climatic factors and pollution;
- (h) archaeological sites and features, architectural and historic heritage, urban conservation areas and other cultural assets;
- (i) landscape and topography;
- (j) land use, including recreation;
- (k) any other relevant environmental features.

The following should be noted: scheduled properties, conservation areas and zones, Nature Reserves, protected buildings and sites, and other sites and areas listed from time to time as having "archaeological, architectural, historical, antiquarian or artistic importance, as well as areas of natural beauty, ecology or scientific value". Also to be included are "visual effects on surrounding area and landscape; effect on open space and recreational opportunity; perception.... by people in the area; contribution... to cultural values".

A much deeper level of understanding and knowledge is needed for the higher-level Environmental Impact Assessment. The above list, given in Recommendation 4, though, is enough to show what, by law, needs to be reported on, and that to do it to European Union standards a variety of experts are required, no one person having all this expertise.

The computer rule of Garbage In = Garbage Out is now well-known, and using the American "garbage" (which in English carries extra meaning of dirt and unpleasantness) emphasises the point. If what you put into a computer is garbage/rubbish, then, however high-flown and meritorious the programme, all you get out is garbage. In environmental work it is Garbage In = Destruction Out. Water pollution, soil erosion, plant behaviour etc all have their inherent properties and behaviours. If these

are ignored in what goes into an assessment, the result will, environmentally, be awful.

*Now this is the law of the green earth –
as old and as true as the sky
and the land that shall keep it may prosper,
the land that shall break it must die.*

(adapted from Rudyard Kipling)

There is no avoidance or evasion. Intention is irrelevant to actions in the natural world. Actions have consequences; this is the Law. The consequence is the same whether the action was done for the best of all motives, or the worst.

In the present (1997) situation in Malta, most people ignore widien, their fascination not being even conceived of. Some people are sure the valleys have a purpose; they have been set there (by Providence?) as rubbish dumps, for hunting, trapping etc, for off-roading, abseiling and canoeing, for pouring concrete over, and various other equally pleasant and harmless pursuits. A few people are already much concerned about this conservation status, and readers of this book will be joining that number.

What can be done? Expertise is sparse, ignorance abundant, and the (unintentional) wish to destroy, deliberately or by neglect, all too prevalent. Remember – *Without public acceptance plans will not succeed.*

There are various ways of tackling this, the one given below in Recommendation 5 is by no means the only one, and in any case should be modified as experience shows which parts succeed best.

Recommendation 5

A group of experts meet, either on their own initiative, or at the request of a Local Council or other body, or an individual. All experts are familiar with the principles outlined in the book, and some bring expertise in e.g. water, pollution, roads and bridges, planning, etc. as appropriate. This group considers the following for the wied in question (which may be small or large, a short piece or a whole river system).

What is the planning area?

- (a) List the people and organisations known to have an interest in the area (from the Water Services Corporation, through walkers and farmers, to off-roaders).

- (b) Acquire basic information (only that easily obtained e.g. present land use, recreation, landscape and geomorphology, water status, historic and natural conservation status)

What is the present situation?

- (a) Is change desirable? If so:
- (b) What needs to be changed?
- (c) How can the changes be made?
- (d) Which, provisionally, is the best option?

Set the scope of the plans.

- (a) Set the planning period.
- (b) Identify constraints or possible constraints on plans (e.g. Planning Authority goals, hunters preventing access, quarry damage).

This is a discussion document only, and must be drawn up accordingly. It will never succeed if presented as a *fiat accompli*.

Recommendation 6

Arrange a meeting (at a place and time suitable for the least mobile of those coming – those over 85? those with three young children?).

Between one and two dozen is a good number. These should include one or two (but not all) of the group of experts, representatives from all established groups using the wied area (teachers, farmers etc) and from such groups in the local area (women's, church, Council, Guides etc), and such individuals who have asked to come, having been attracted by local posters, notices in the papers etc. All should have a copy of the discussion document.

At the first meeting, develop a written statement of the group's beliefs on the project. If all cannot agree, place the agreed opinions first, followed by "minority opinions".

In subsequent meetings, first develop priorities, then written and obtainable objectives. That is: "Stop all pollution" is not realistic, but, "Investigate and list all sources of pollution, report illegal ones to the authorities for action and prosecution, consider ways for lessening or stopping legal ones", is. "Take down all dams" is not an attainable objective, but, "Consult the relevant Departments and landowners about the value of each of the present dams, the necessity of their present height, and the cost of some removal", is an obtainable one.

The meetings thus far should have created a local group with an agreed wish to improve their local environment, and have agreed ways in which to do it. Their findings should by now be known in the community.

Recommendation 7

The group here takes its written statements, together with the original discussion document, and develops a Plan of Action, starting with their agreed priority objectives, and then working down the list. For each objective the goal is stated first, next, the reasons why the goal is important, and thirdly the means by which it can be achieved.

This must be looked at in detail:

- (a) What people can be called on locally? **All can have a role.** The young and active can plant trees, cut overgrowth, put up fences etc. All these practical activities (even picking up rubbish!) must be taught, so that the task is done well, with least effort and maximum safety and effect. Experts to do these may be available in the community, or be asked for from conservation societies, Government Departments etc. Those no longer feeling up to digging all day have equally important jobs in fund-raising, writing newsletters, delivering newsletters, arranging for notices to be given out (e.g. in church, in shops), planning demonstration projects, etc.

It is vital to realise that most conservation is not the business of Government, but that of the local community. The Government has always too many things to see to: the Health Service, Foreign Policy, major infrastructure works etc. Only major principles of conservation are proper tasks of Government: legislating against valley destruction by quarries, against dumping, imposing heavy fines for pollution etc. The rest is for voluntary organisations and individuals.

- (b) The people known, the implementation can be worked out:
 - exactly what needs to be done, and who can do what parts.
 - What personnel need to come from elsewhere? How?
 - What equipment needs to come from elsewhere? How?
 - How much money is needed? How is it to be obtained?
- (c) The Working Plan can then be drawn up.

It is vital to cast no blame. Recognise the good things done by

those using the widien. Even if the results of such use have been devastating, it is possible to state how good it is that groups have found interest in the valleys. The emphasis must be to build on the good, and to educate those doing harm. The first objectives carried out should be those achievable in a short time (one afternoon?) with the resources the group has available to it. This builds up morale and encourages the desire for greater things.

- (d) The Working Plan includes what the project cannot do, and why (cost, law, no social acceptance, takes too long etc).
- (e) Whenever a plan may offend identifiable people (farmers, recreational groups etc) it is essential to meet these, and explain what is intended, and why. No legal rights of other land users may be infringed. When law is not involved, a discussion can often produce a friendly way out — wire or fence put up by the group ensuring no trespass on crops, may make farmers happy to have visitors walking by, for instance. It is *not* "The group is doing this" but "the community would like to do this, how can we do it without interfering with your rightful use of the land?". If the community's legal rights are infringed, that, of course, is a matter for the police.
- (f) The provisional Working Plan is sent back to the original group of experts, to be seen by them and by whatever other experts they consider appropriate.

This is vital.

It is easy to e.g. consider grazing or horse-riding as "natural" and therefore harmless country activities, or to make inadequate provision for sanitation, or even to encourage school children to pick just a few flowers each, without realising the unfortunate consequences of all of these when large numbers are concerned. **It is equally vital that the approved or amended plan be returned to the group in less than two weeks, so impetus is not lost.**

Implementation of Plans!

By now there may be many sub-groups, all engaged in different activities, for instance:

- (a) wardening the site on weekends, pointing out features of interest and

- discouraging damage;
- (b) producing literature and photographs to be sold by Wardens;
- (c) tree planting, or tree maintenance;
- (d) creating footpaths which keep the public off most of the land — by pleasing the people;
- (e) removing overgrowth;
- (f) fundraising;
- (g) producing Newsletters to all interested persons;
- (h) liaising with police to stop illegal activities;
- (i) and many more, all varying with the type of site;
- (j) It is important though, that the original group (with replacements as needed) meets regularly, to:
 - evaluate the achievements in relation to the Working Plan, and adjust, if necessary;
 - do things which keep the group together, such as 7 (a) above developing new plans, having “fun” events etc;
 - give awards and recognition to those, outside and inside the main sub-groups, who have done substantial enhancement work.
 - using co-ordination with appropriate places of education and work, make participation in relevant projects count towards qualifications of various kinds (gardener, forester, landscape planner, waste disposer, conservationist, amenity planner, publicist, public speaker etc);
 - arrange media coverage.

It is community projects that have been described. The same plans can be adapted for schools, conservation organisations etc.

The role of the Government is to give protection under Structure Plans and the Acts which enforce them to give protection, by requiring Environmental Impact Assessments and Statements when changes are contemplated (to reject and replace those of inadequate standard), and to require developers to carry out the environmental recommendations. Government should also enforce the laws. Government has more specific tasks in the protection of quality and quantity of water. This task could be extended and take a much wider role in decreasing pollution. Government also should forbid damaging activities such as concreting land without environmental guidance, infilling wadies with rubble for roads etc, dumping rubbish or rubble, leaving obstructions which are flood hazards, off-roading (without environmental guidance, the collection or killing of valuable animals or plants, quarrying in valleys, and see Chapters 14–16 for more. Government should also maintain Government land, or lease this, with funding, to organisations who will maintain it.

These tasks give the broad framework: “Thou shalt protect, thou shalt not destroy.”

Government also provides funding — but never enough! Even if Malta found oil and became rich beyond all dreams of avarice, Government should still not provide all conservation funding or work. It is only by local involvement that places are protected: paint is sprayed on prehistoric temples by those who have no idea of their Maltese and International value, not by those who have had the privilege, and realise it is the privilege, of working for their preservation. Government money is, however, required for major projects, and to help along many minor ones.

A further recommendation is the establishing of a group of Conservation Volunteers, people who enjoy spending time working with their hands — planting, removing rubble, putting up fencing, creating picnic areas etc. This would be highly desirable. Young people in other countries take much pleasure in this. It gives the fun of working together for the good of the land, and the achievement of accomplishing something for the country. The British Trust for Conservation Volunteers was the pioneer, and (under other names) now has affiliated groups in many other countries. A Maltese group could either be independent, or draw on the resources of the British Trust (contact: British Trust for Conservation Volunteers International, 36 St Mary's Square, Wallingford, Oxon OX10 0EU, England). Either way, in the early stages, experts would need to teach all tasks, though soon most expertise would be held within the group. Such volunteers are then available to help, lead and support the practical side of local projects.

Appendix 1.1: Content of a Land use Plan

1. *Summary*
A summary of the goals, proposed changes and methods for implementation, giving a clear overview of the essentials.
2. *Terms of reference*
Area, problems and goals.
3. *Present state of the area*
Description and discussion of the status of the wied, in all aspects (from archaeology to air pollution!).
4. *Land uses desired*
Improvements wanted, in terms of stopping unwanted activities, starting wanted ones, both short-term (e.g. tree planting) and long-term (e.g. wardening, tree maintenance). Never destroy "Sense of Place".
5. *Alternative plans*
Work out in some detail, alternative methods of achieving the main objectives. Advantages and disadvantages are given for each option (e.g. amount of money required, co-operation offered from landowners). One plan should always be the "Do Nothing" option, together with what is expected to happen, should this be chosen.
6. *Best practicable option*
The chosen plan, with the reasons for choosing it.
This is supported by maps of the proposed changes and details of how these are to be implemented (people, training, supplies, research, transport, timing, finance, etc).
7. *Problems.*
Limitations of law, custom, vandals, money etc.
8. *Monitoring and revision*
How the degree of success of the plan is to be assessed, procedures for on-going revision of methods.
9. *Supporting information*
Detailed information gathered during planning (e.g. tree distribution, flood hazards, waste dumps, inventories of rare plants and animals, river-worn stone, summaries of interviews with farmers and other land users).

This is necessary, so that people can understand the reasons for decisions taken and, where appropriate, change these.

APPENDIX 2 RIVER TRAILS

Introduction

It is much to be hoped that, as a result of this book, well-signposted trails (for car and walking) will be developed all over the islands, with features well-marked, illustrated booklets available, wardens to consult, and no fear of vandals or lead shot. At this stage, though, this Appendix merely provides a description of a few places to go, and of some of the things that can be seen. Most detail is given at the start, so the descriptions should be at least read in order and preferably the first three trails visited first. Species lists for parts of trails for River Ghasel, the Gnejna Valley and Wied Has-Saptan and 7 are given in Chapter 3. These descriptions were correct at the time of survey, but places can change quickly, in Malta. Seasonal changes are also great.

Readers should buy two maps, a Street Map which shows all roads (but the rivers are not always clear), and any of the tourist road maps which show rivers in colour. Parking (for looking from bridges and walking along wieden) is seldom possible on the principal highways, but is relatively easy on main roads (getting off the road) and on minor roads. The smallest lanes are single-track, and parking in the infrequent passing places is discourteous unless space is sufficient for passing vehicles also. These small lanes may become steep and untarmacked and be between high walls.

The field study guide "Let's go to Chadwick Lakes" (Haslam 1998) will be helpful.

Warning! **Malta is unsafe.** If there is a road block by hunters on a public road, do not insist on your legal right to pass it: better go elsewhere than be abused or hurt. Otherwise, public roads are always safe. During the open season for hunting, local advice should be sought before going far from the road. In the close season (which varies from year to year), more places are available, but, because of illegal shooting, local advice on access

should again be taken.

To insist on your legal right to walk on Government property, namely the floor of (most) wieden, is not recommended.

To so much, the hymn quote applies: "Where every prospect pleases and only [recent effects of] man is vile."

River Sewda System: Wied is-Sewda from the Zebbug Road Bridge to the Sea. (also see Chapter 12)

All here can be seen from roads. Upstream and in Qormi the trail is pleasant to walk. Downstream, it is better to drive along the busier roads.

Post-scriptum. Severe dredging in 1998 has altered the upstream part.

Upstream of the Zebbug road bridge the ugly quarry rubble dump should be looked at as an example of what should not be allowed to happen. Now it is even extending into the river bed. The bridge itself should be seen from both upstream and downstream: from downstream it is unique, with its unusual piers. Upstream it has been altered, and is more usual. The dam is well-constructed. (The examination shaft hut, when this book was written, had its door left open for a year: a telling indication of the efficiency of the "regular" inspection and maintenance.) Heights, types and strengths of dams should be noted along the river. The vegetation above the dam, though, shows all too clearly that water seldom accumulates here. With the quarries cutting through the rivers above, letting most water, with its pollution, sink into the aquifer, how can it accumulate? In Malta, the right of the quarry to waste water is greater than the rights of farmers or the Water Services Corporation to use water. Rubbish is dumped here, also, and, on the downstream side of the bridge, so is slurry and sludge from pig etc. units.

The river is walled. One side has an old retaining wall. On the other side, the newer wall has been built within the old bed, to create new land. The building to the west is a pig farm. Note the water exits, and the deterioration of the part receiving storm flow. Trees (*Ricinus communis*) cover the bed — creating what would be a flood hazard if the storm water exceeded that lost in the quarries. The next building, a pump house (on the east), was built a century ago (Mr Chadwick), when scouring water was

usual, and very fine buttresses project into the river bed. With a then useful river, there are good access steps down to the water. Below, there is a small wall (or dam?) across, whose past use is uncertain. The channel is narrowed by road building. The other bank is also disturbed, but at least has a good variety of vegetation.

The next bridge is of the common old farm type, built straight across for carts, now given spaces at each end for cars and small lorries to manoeuvre. Cart ruts can be seen in the bed, grooved into exposed *Globigerina* limestone. The bed structure is satisfactorily variable, but the banks are of a disturbed 1:2 slope. Further along are more cartruts and more limestone outcrops. In wet weather there is not just water, but polluted water, discoloured, turbid and perhaps with pollution-tolerant algae. The pollution probably comes from farms. Rubbish comes from anywhere, and is found all the way to Qormi (and indeed to the sea): so will not be commented on further.

The banks deserve attention. There are *Globigerina* outcrops, old walls near and above the river, dug and excavated banks of different slopes, and extra banks built up for protection.

In this part there is water (in wet periods) and run-off, and therefore parts of the river are dangerously narrowed by hazardous loose rubble (on which access roads are sited). Why was this allowed? Alternative ways of making access roads, which would not be flood hazards, were possible (How?). This area has many impoundments. The water is often disgusting (and look for the pipes coming from farms — if the farm effluent, usually pig, drains in). This water is then put on fields, to pollute the vegetables which we then eat. Some of the water sinks to the aquifer, so we can drink it from the tap. The aquatic vegetation tells the tale clearly: the separation between the dry, unpolluted plants above, and the polluted below cannot be missed! The degree of pollution varies: note the smell and colour of the water, and the amount and species of vegetation. As the impoundments have been over-excavated, this land vegetation above, though clean, is seriously damaged by disturbance and is mostly ruderals.

Here the dams are of the Good Luck Valley Scheme (Risq il-Widien) (1980s) type. Each should be examined downstream. How many are being broken down by storm water? Have any been repaired? Farms (many with livestock) occur at the sides, some expanding and doing more damage to the wied. Infilling, pollution and rusty oil drums add much to the "ornamental" scene. Some oil drums protect new eucalypts planted by hunters. Trees are good: but why the exotic eucalypts? No sense in causing yet more damage!

The increased construction in the valley is destroying its beauty and increasing the flood hazard. The latter is surprising considering the damage done to Qormi by the 1979 and indeed the 1997 floods, which are feared. Damage, for the same rainfall, is worse now — but apparently this does not matter.

Entering Qormi, the next source of pollution is seen on the right: a scrap-yard, with metal, acid etc run-off (and until recently, no protection). Then — where is the river? Through the town it has now been asphalted! This is a loss of cultural heritage, a loss of the feature around which the town, Malta's only "River Town", was built (see Chapter 6), a loss of the opportunity of having a fine urban ornamented river (of which there are none in Malta), and a degradation to drab uniformity. Storm water is still carried, and asphaltting a river bed as if it was a road can have results expected only by those who know it was not a road. The "river road" (now named Triq il-Wied) has the main sewer (late 1980s) with intermittent blocks (unhelpful in a road). The foot bridges are of course over what was the river.

It is, in fact, of interest to follow round:

- (a) the line of walls of the old town;
- (b) the line of the river;
- (c) the other roads, and work out the relationship between them;
- (d) houses by the river:
 - old, with doors well above bed level
 - new, no concern with flood
 - near an entrance to the town
 - with an obvious river purpose (e.g. Sta Marija Traveller's Rest Chapel, see Chapter 9)
- (e) how much was protected by walls (see Chapter 13);
- (f) where does run-off come in;
- (g) pipes from walls/buildings — at what height (high, to put in sewage above a then-higher water level, or low because newer, or other);
- (h) where does storm water enter:
 - above ground (on roads),
 - below ground (on old tributary lines, some marked by manhole covers).

Qormi repays study, even now!

Downstream of Qormi, the channel is, effectively, lined all the way to the sea. There is a nice bridge, pipes cross over, and soon the river is again

walled and very messy, badly polluted, and mess is apparent really because this pattern is inappropriate in a town, where the river should be ornamental. There are inflows from pipes, from roads, and (very dirty) from the Sta Venera tunnel. The general lack of thought shows on the river, and prompts queries on what the inhabitants wish: concrete? tidy? pretty? unique? efficient in waste disposal? clean water? ugly mess? — any wish can be achieved. The river bed is well-walled, as is necessary in an urban area. When it was built, floods were remembered.

The open ground downstream has the interesting and old narrow cross-dams in the channel (described in Chapters 5 and 13). These are not strong, so clearly much water of low force was expected in the river here in this flat ex-marsh. This reach is unique.

The Kbir river enters to the right, and so does run-off. The bridge is pleasing to look at, less so to cross. In the Sportsground, the river is well-concreted, but well-vegetated in suitable seasons and with suitable deposited silt, or cracks, in which plants can anchor. There are nice trees (see Chapter 12) and *Arundo donax*, and it is an example of ornamentation which, in the Marsa area, is proper. As ornament it is adequate, though not good. It is much better than Qormi, though!

Downstream the water is dirtier, and is awful by the bridge. In appearance it is as bad as that from the pig farms, but chemically it is far more toxic and dangerous. Here is pollution from roads, industry, stables, golf and various other nasties.

Below the bridge the river is fully industrial, with pipes, industrial buildings etc. It is interesting, just for that reason! It is relieved by the charming bridge at the mouth, and the important Entrance Victoria Bridge (see Chapter 6).

Purification of this worst-polluted Malta river has not been thought of. While coming down the trail, visitors may like to note where the following could be inserted: cleaning of effluent at source; buffer strips to prevent dirty leachate reaching river; silt traps for run-off; vegetation in main river; vegetation in open channels bringing in pollution; diverting effluent to sewers. What else?

Also, both trees and larger animals can be noted. What tree species? These should be native ones except in and below Qormi. How many? How much diversity in architecture and provision of shade and habitat variability do they provide? What animals are present? Which add to the environmental good (e.g. birds)? Which have a useful function (e.g. farm dogs)? Which are detrimental, and why? Do pigs need to pollute the river? Is there

sustainable grazing or, with all the other disturbance, has the amount of grazing which was satisfactory earlier become damaging? Finally, where are (obvious) sources of water abstractions: boreholes, stand pipes, removal from impoundments, other?

**River Kbir System (Widien Qirda, Kbir and Cawqli):
from the Siggiewi Road Bridge to the Sewda Confluence.**
(See also Chapters 2, 3 and 12).

The River Kbir System can be partly seen from roads, but part is a beautiful walk: however, see warning above. (Introduction to Appendix 2).

The bridge itself is rather dull, but downstream much rather turbid water can be found in winter. Springs have decreased: half a century ago swimming was possible in the driest part of summer (cleanliness has also decreased!). The watercourse is still wide and deep (check its shape, to compare with profiles downstream).

There is an *Arundo* clump which, like all such, needs watching for explosive growth.

The dam is at a nick-point in the long profile, as is typical for the early ones, sited on springs. The side wall needs repair. General mess increases, and there is local conflict of interest, a notice begging people to preserve (this rubbish) as a Gem of Nature — which it never was. A seventeenth-century chapel is near, a Gem, but of History, not of Nature.

One bank then has a good rock and wall structure, the other is not only messy rubble, but also over-narrowed, while “pretty” oil drums add to the joy of the view. From here, the start of the beautiful lower Coralline gorge can be seen, but the beauty is there only if you studiously avoid looking at much of the foreground. Where undestroyed, the bed has an interesting structure, and the slope has woody plants (which stabilise it). Try not to look at the new rubble track.

Some walls here are exceptionally beautiful, with varying patterns and even with access steps. Most are excellent (and spot those which are not). The next farm track across is, at least, on a bridge and not just on rubble causing a flood hazard. The walls on the valley above are less good. Rubbish recurs: and as before will not be commented on at its every site: there would

be space for no other descriptions! There are beautiful and striking country houses perched actually on the side of the valley, blending in with, and enhancing the landscape. Their frequency is just right. Woody trees and shrubs grow well on “unused” rocky scarps, but wall maintenance is poor.

A dam has a wide filled impoundment above it. Fennel (*Foeniculum vulgare*) does well, the soil here is dry and disturbed in summer. The tree'd sides of the valley are admirable. The gorge then narrows, and the structure of the bank and bed (rock, depth variation, vegetation) are all fine. This part is winter-wet. When a dam is there, this shows that some storm water occurred not too long ago. The name Qirda means “destruction”: attributed to fierce storm flows. Lanes give access, but are unobtrusive.

The gorge remains spectacular and admirable, with trees on steep rocky slopes, along the scarp base (spring line), and sometimes on flatter areas. Terracing was done where possible, but because of the difficult terrain it is not surprising much is now dilapidated. Climbing should be controlled, though. One climber once a year is sustainable, hundreds are not, destroying first the rare cliff plants, then the rock surface.

The walling and general construction are attributed to the knights and are good enough to be so.

The dams are there, so of past use, but are of negligible present use, except in severe storms. At the sides the walls blend in with the rock. Excellent! A track follows contours gently into the valley. The bed and banks continue with good (dry land) vegetation, and good structure, in a landscape as much managed as the rock outcrops permit (properly **managed**, not **damaged**). There are caves above. That with the oblong slab is called the English Lady's Grave. Others have fine structure, and (at least) past use. Citrus trees increase in damp and sheltered places at the edge of the valley floor.

The Wied Qirda and Hanzir confluence marks the start of the Wied il-Kbir proper. Here is the cave called Ghar Hanzir. This is a swallow-hole which reputedly has an underground channel down to Marsa. The swallow-hole would certainly take much of any water flowing over it. This marvellous feature is being covered by rubble: it appears to be legal, and it is certainly socially acceptable to destroy such features. There is much interest and beauty up the Hanzir, too.

Some newer steps (British) are to be seen on the right, below the old RAF runway, giving access to bomb-proof storage. Probably older steps for access to water were re-made.

The wied now leaves the gorge, passing to a lowland region. Here there is mess, a flat bridge, and disturbed ruderal vegetation (fennel, *Foeniculum vulgare* etc). A great contrast to the gorge above! Here there are roads and disturbance (but at least still a river bed, unlike Qormi). Coming into the alluvial drained plain of Marsa (and, technically Wied ic-Cawqli), the channel widens, where formerly the freshwater and estuarine marsh met. This wide channel is striking and unique. It is grassed, bounded by trees and walls: a type found, indeed, further north. Before joining the Sewda, the channel becomes more messy with more ruderals.

River Ghasel System (See also Chapters 2, 3 and 12)

Described here as a drive looking at selected parts. Much recommended for more detailed survey.

Upstream, visit the Liemu, Busbies and Ghemieri (with the Ghomor). Contrast these for "Sense of Place". All are upstream sources. The Liemu has a Blue Clay basin, which is well-farmed, with a scarp above and much spring water. The (western) Busbies rises on flat karst, flows over a slope, becomes woody, and passes to a lowland area collecting water only in the main valley below. The Ghemieri tributaries rise on moderately sloping open hillside. What makes the "Sense of Place"? Look at all connected with water (including scarp bases, boreholes and all springs as well as channels, and their flow, size, pollution etc). The Ghemieri is more representative of present Malta for land use — but why? (Not the quality of the crops). What about karst, garigue and maquis? How much does the width of the road and the amount of traffic carried affect the perception of "Sense of Place"? Watch out for bridges, the packhorse ones and simple farm slabs on the Liemu, the arched old farm one and the more usual type on the Busbies — and what, on the Ghemieri? Also for the dams. Where do they start? Which are the (characteristically made, and strong) Chadwick ones? Which are those sited at nick-points in the long profile? Those on near-perennial springs? What about chapels? The Ghasel has many, from the Carmelite Chapel on the Liemu to the Annunciation Chapel at Salini. These are a study in themselves. Are any, though near the river, unconnected, i.e. not properly "River Chapels"?

Finally, of course, study the river channel all along: width, depth, water (if any); bed and bank structure and architecture, vegetation community,

diversity and architecture: and what the factors are that control each of these. What were (or are) the water-related uses? Is there anywhere that recent human influence has been beneficial to the habitat? Or where traditional human influence was not? What conclusions can be drawn?

The second section to be visited starts near Fiddien Bridge and follows the Middle Ghasel, with plenty of bridges for viewing and, in part of Chadwick Lakes, a riverside road, down to below Mosta. Here are the well-made dams, with impoundments above. Which have been wrongly dredged? Have any been properly dredged (see Chapter 16)? Which are oversilted and need dredging? Where is other maintenance needed, to dams, walls, pipes? Why are most dams in the upper part (more springs and water)? What can be done to prevent so much silting in the impoundments? A nuisance there, but it was the most valuable top soil on the land, before it was washed away. Why is there such "siltation" here and almost none at the Qirda (above), which also has a large catchment? Compare, in wet seasons, the deplorable monodominant impoundment communities with the diverse and variable ones on undredged land. Further down, where water is less, study the (admittedly less interesting) land vegetation. What can be deduced about loss of water, dredging, increase of disturbance recent alteration for recreation and other forms of human impact?

What makes the middle Ghasel beautiful, or ugly? How much of a part is played by the trees and water? By walls (deplorable in the Qlejgha) and dams? By roads and new or old housing? What constitutes "Sense of Place"? Are areas with "Sense of Place" always beautiful? Where not, which should be most enhanced (given "Sense of Place" is not provided by rubble, garbage, pollution or equivalent!)?

St Paul's Shipwreck (Seamen's Rest) Chapel (see Chapter 9) by the large cross-roads down from Chadwick Lakes, is a "must" for visiting. See the front facing downriver to welcome pilgrim sailors. Examine, but **do not touch** the ship pictures on its walls, and **do not add anything to the walls**.

Why is the river much duller in this next stretch? What could be done? Approaching Mosta is approaching the famous Ghasel gorge. Just upstream of it, though, is the second of the three "must" chapels. Visit the cave — or, rather, look in through the grating — of Our Lady of Good Hope. Is it good to put a false or prettified grotto into what is a real cave, itself hallowed by long worship? What would have been better? Here, on the fringe of Mosta, exotic species (Canary Island palm, Stone pine, mulberry,) as well as carob and Aleppo pine are found in the wied. Is this sufficiently

urban for them to be acceptable, or too rural and should they be removed? Once really in the gorge, the effects of excessive human impact — deliberate and accidental — are all too clear. Compare the vegetation with the Qirda. By now, those following these trails will be able to list the damage done — apart from the quarry damage, of course. This, apparently with the goodwill of Mosta and the law, has removed part of the unique gorge wall, caused fallen rock in caves, destroyed habitat and part of the Victoria Lines and threatened St Catherine's chapel. What can be recommended?

It is St Paul the Hermit, though, the church in the cave, that is the third of the three exceptional chapels here, which also deserves a visit. Here is the only part where the valley floor is very wide, and farmed. The watercourse is at the side. Such farming is culturally and economically interesting. What about nature conservation?

Downstream of the quarry are more impoundments, polluted by quarry dust and debris. The Ghasel emerges from the gorge, and passes down to its lower section, the Salini or Burmarrad plain (formerly a marsh with water further inland). The last dam is by the road across from Burmarrad. Downstream of this, find and mark out the causeways. These are wide enough for mule or horse, and are made of larger stones than dry walls. Also find the bridges, the walls bounding the old Ghasel channel, of which one side is a causeway, and that channel infilled and cultivated. The present flood Way can be seen (in wet weather). And, finally, in the estuary at Salini, note the exit pattern, the Waterworks borehole, the exotic yet pretty trees — **outside** Kennedy Grove, therefore wrong — and the (water) reed *Phragmites australis* (which is smaller than *Arundo donax*, also present) a totally proper plant to have growing here and in the wetter fields.

The Wied Ghajn Rihana rises as what is now a winding farm track. Below the road, the increase in channel size and water quantity is striking (and there is a nearby reservoir). Note the unsatisfactory concrete spillway. From here to the Ghasel confluence is the (wet weather) longest stretch of good aquatic vegetation in Malta, nice and diverse, an adequate channel (given the constraint of a well-farmed district), and the only complaint is that the very satisfactory tree'd sides of the river include too many exotics. *Typha domingensis* (bulrush) is, regrettably, spreading with the increasing pollution, while more pollution-sensitive species decrease.

The Wied Qannotta, in contrast, rises on karst, goes into a wooded gorge, which later turns, enlarges, and opens so that the river flows down a wide, distantly-scarped and terraced valley. Farming is below only,

unlike the Rihana, and much of the channel is dry. The shapes of channel, bank, immediate valley and general land form should be looked at everywhere. Can you find any two rivers that could be mistaken for each other (unless badly degraded)? What makes each unique? Briars cover part of the middle bed here, there is a dam (cracked) and the modern interesting kind of farm bridge. Where *Arundo donax* clumps appear, damp or wet also is appearing. These places can be noted, and the water source found. In the lower part the road runs by the stream, making observation easy. Earlier, the Qannotta flowed into the Burmarrad marsh. Now that this marsh is drained, a shallow narrow grassy channel has been dug from the village (which the stream formerly supplied) over the plain.

Gnejna Valley

Some can be seen from the top above the scarp, and a road runs along the lower part. Behind the scarp is a large depression, a former marsh.

On the top is a gnien farm (see Chapter 5), built on flat ground above the springs which supplied the farm land. It is clear the flow there was perennial and substantial (Why?) and the gentle dip in the scarp above shows the start of the main stream. The scarp is a V, not a cwm, and it drops steeply. The gathering stream is partly marked by *Arundo donax*. Check the distribution of woody species: how much on inaccessible places, on spring-lines, in orchards, or for other reasons? What are the species? The stream can be examined along to the next access point, where the road comes in. Before leaving, look at the panorama of the Upper Coralline plateaux, the scarp below, followed by the wider terraced slopes: and note that the terrace walls differ much in pattern (How? Why?). The spur between this Gnejna valley and the Santi valley to the east has narrow steep terraces on the Gnejna side. The soil varies in colour (Why?). How much of the terracing is determined by slope, how much by land tenure or other human choice? Once established, are patterns changed?

Where road and river meet, stop. First — unless it is mended — notice the collapse of the retaining wall of the road, and that the fallen stones dam up and cause little pools in the stream below. In this little-settled part of Malta, water has been taken less, and the Gnejna flows (near the springs) for a respectable part of the year. Returning to the site, pipes etc lead run-

off from the road and the slopes above to the stream. This is mildly polluting, (the road not being very busy). It is, though, enough to show in the stream (which may also have other pollution). Upstream, the view goes to the scarp, and shows the damp gnien, woody and *Arundo* areas. Close to, there is a well-marked bed about 10 m wide, with terraces above. This bed has within it the present flowing watercourse, mostly less than 1 m wide. The 10 m channel has no sign of recent cultivation or use, though presumably it is some while since there was enough water to fill the whole 10 m of it. It is still damp (as shown by the presence of *Scirpoides holoschoenus*). The water would have been mostly spring water. The catchment for rain-water is small here, and the retaining walls of the channel are low, indicating no (or very rare) high floods. The (present) stream bears a fair aquatic flora. Mr. E. Lanfranco finds it now improving and recovering after a bad pollution by herbicides.

Downstream at this site there is no 10 m channel. Instead, on one side a field, on the other the road, have encroached into it, with their retaining walls. The present narrow channel is obviously more than large enough for the present water flow. The upstream and downstream channels form a nice contrast in size, age and water at the time of construction.

Going downstream, the road continues by the river for most of the way to the sea. Width, bank-height and steepness should all be observed (the steep banks are of course man-made, dug in stiff soil or walled). In part there is a good deep channel. Look around at the valley maintenance pattern, and for the access tracks for the fields. There is a track on the further slope which heads towards the sea: the present road is new. How much of the fields, and of the walls, are in good condition? How much is abandoned? Why?

The aquatic vegetation is nicely distributed. The river farm in the middle has a dam, a good old-fashioned type of dam, obviously built to collect water. In view of the water loss, though, it has been no good as a water collector, it was infilled, and is now a useful field.

There are a couple of nice farm bridges, one sloping steeply down from the road. This is unusual, as most bridges are horizontal. It was built after the present new road was constructed, as only then was there a height difference between road and field.

The *Arundo donax* pattern should be watched. Is it in control or an overgrown nuisance? Where? What keeps it in check, the habitat: management? At the sea, is the mouth clear of *Arundo* on the bed because sea water poisons it, because river water scours it, because people cut it, or for other reasons?

Mistra Valley (also see Chapter 3)

Access to the Mizieb is off-road, but some can be seen from the road above. A road runs along the base of the Mistra Valley.

The Mistra Valley is in two parts. The upper part, officially the Mizieb, is a depression in rocky garigue, with dry farming in the depression. The Mistra proper starts downstream of the high road bridge, and there are springs and ample water, a green valley and irrigated crops. During the hunting season the Mizieb should be looked at only from the road above.

The Mistra rises in karst, with walls which have nice flowholes. In the first cross wall near the start of the V-shaped watercourse, there are two square flowholes. The bed drops down in the limestone, as is common. There is some scarp above, perhaps before with good springs, now usually dry. There are limestone blocks in the bed anyway, through which water would sink. The bed widens to 8–10 m, with a nice little scarp, close by a second (well-constructed) dam, and the scarps have the usual woody vegetation. The wall across is likely to be a terrace wall preventing soil loss; with the dam designed to trap water occurring further down. That dam is usually useless for water conservation, but does alter the vegetation, as silt and damp are found above it, with *Rumex conglomeratus* etc. This is in fact over-silted and needs (careful) dredging. This dam is visible from the road above, and from the road below. Around the road bridge, the transition to the Mistra proper is marked by a varied vegetation of briars, fennel, sticky samphire etc, considerably disturbed. The bulk of the vegetation increases, marking the changeover to the more fertile valley below. The rocky sides of the Valley harbour served for punic tombs and apiaries from the Middle Ages.

In the tunnel under the highway bridge, the stream channel is at the side, with slabs of stone (i.e. movable) across the top. There are also run-off pipes bringing in the polluted highway run-off (much worse than that of the Mistra road, which carries only a little traffic). Rubbish, regrettably, increases once there is easy access to the watercourse.

In the cliff above the road is a spring locked with a door and closed as unfit for human consumption (excessive agrochemicals and other pollution). The sealing is recent: so the pollution, the reason for the sealing, is recent. The increasing difficulty of watering the Mistra walled fields has been attributed to the loss of this spring.

The completely lined nature of the channel by the bridge is acceptable,

but the lining continues much too far down for this rural, and not high-risk, area. Good briar grows at the sides, together with trees. Most regrettably, the trees are exotic eucalypt, which should be removed and replaced. Scenically they are fine but the habitat they create is poor (as previously described). "Sense of Place" would be better conveyed by poplar or pine.

The channel contains the mixed fennel-*Arundo donax*-fescue (large grass) etc community, but after the first farm bridge *Arundo donax* becomes, and remains, the main dominant all the way to the sea. *Arundo* has increased since the 1950s, when the pattern was that of a controlled and harvested population (as e.g. in the Santi now, see Chapter 13). Here it is a serious conservation hazard, preventing the occurrence of native vegetation, and most should be removed.

This is a good point to look round the valley, and see the high amount of water storage, of springs, of abstraction from the water table below, of water channels: on the valley floor, on stilts and in grooves in the rock (on the right) leading to what were animal-drawn mills. These were working in living memory. Surely one should be restored as historic heritage? Where did the water in the grooved channels come from? All the water patterns can be picked out, those whose water makes this a green and irrigated vale. How high up the slopes does the farming go? What is above? The same as in the Mizieb? Why not? How much of the water reaches the stream? Not much! Pick out the wall pattern, the field access pattern. Then, how much rubbish is there? How many oil drums?

Continuing downstream: where is the *Arundo* not dominant, and why is it not? What about farm crossings? Rubbish and oil drums? Which enhance, which give "Sense of Place", which give interest, which degrade? What types of wall exist? Old walls, new walls, and what size and shape of stone?

Approaching the sea, sticky samphire increases and *Arundo* decreases, stopping where sea water reaches it.

Try listing the characteristic features of the Mistra and the Gnejna, starting with the water resources. What differences can you find? Do they account for all the variations? There are many tiny or subtle characters due to a long-continued particular local management. Photographs may well be easier for study: followed by a return to the valleys. What features here can be listed, and what shows only by pictures?

Wied San Niklaw (only intermittent access by car)

Wied San Niklaw shows the value of even small relatively unknown widien! This one lies in an embayment inland from Mellieha. It starts as a cwm, a nice circular embayment in the Coralline scarp, and then drops into a small gorge, well-treed, with well-structured valley slopes above, and some plain walling below, remaining wooded and pleasant. Downstream, the San Niklaw leaves the gorge, and rubble and mess accumulate as badly as anywhere in the drab ugly country: what a contrast! The channel itself lessens and barely exists. When narrow and small, it goes under the road in a tunnel which is hardly more than a road run-off channel. A sad end to what started as a lovely cwm.

Wied Has-Saptan (also see Chapter 3)

This has some roads partly parallel to the valley, some across it. Elsewhere, the valley is dangerous in the hunting season, the surveyor reporting he risked his life here!

Wied Has-Saptan is an example of an eastern (low) gorge valley, with various good or unusual features. The first is the large soak-away near its source! This started a flood relief channel for the airport runway, and is often dry. Nearby there is a borehole (some conflict in planning?). A short, not very strong dam comes next, with not much of an impoundment, but, naturally, with rubbish. Next, the banks reach several metres high, are varied in architecture (walled, dug, dug to a more natural shape) and bear vegetation. Olives were planted in 1961/62 on the spill from the Has-Saptan tunnels. These were dug up for the British Armed Forces in 1959/60, to store fuel, and extend to Birzebbuga and to Ghar Dalam. A petroleum plant crosses the wied, with a grid across the watercourse. Such a grid is a dangerous flood hazard, as it can be blocked by debris. However, the building of the new Airport runway decreases (cuts off) the catchment of this river, and perhaps lessens the storm flow. It is of course understandable that children wander inside industrial sites — but could there not be a child-safe tunnel, as at some bridges? It would be expensive to construct, of course. By here the bed is some 8 m wide, the bed structure is both pretty and varied, with flat rock, stones and soil, and the vegetation is likewise appealing and satisfactory. The channel has a much-walled bank, part

needing repair. A fairly recent wall crosses the wied, more probably put up by hunters restricting legal public access than by farmers conserving soil.

Regrettably, the valley is next part-buried under a high mound of rubble, and the water flow is again endangered by a grid. The bed vegetation improves again, becomes less ruderal, more diverse and more varied in bed habitat. The bed itself is not river-worn (in recent times). Water has been removed, not only by the borehole, soakaway and runway (a large underground pipe beneath the spill carries the water downstream). This section of the wied is beautiful, good and varied in vegetation, bed and bank, and good in vegetation quality. The sides include gorge and slope, cliff, ledge, earth wall and concrete: and rubbish. It is altogether much to be recommended, and conserved. Damage to the traditional pattern has mainly been for birds: to make the area a Killing Field, and to add exotic trees like acacia and eucalypt to the good native collection of carob, olive, fig etc.

There is a curved dam. These are sparse in Malta and this one adds to the variety of type already seen. Like the other dams here, in an average winter no water collects. Bridges are of course present along the valley, and are of a satisfactory variety of types.

This wied has a typical Malta phenomenon, though one sparse in wieden: rock pools on the walls of the valley. These rock pools reach several metres across, maybe 0.5 m or so deep, with beautiful clear clean water (little run-off pollution). They remain flooded for many months. Here are found the aquatics missing from the valley floor: *Ranunculus trichophyllus* (water crowfoot), Characeae (stoneworts), *Damasonium bourgeri* (star fruit), ferns and others. These pools should be studied with care — but the plants and animals must **not** be touched or disturbed, of course.

There is, in the wied, a place which was still a marsh in the 1950s, marsh plants being harvested, and the bed being wet from here to the sea (Bowen-Jones *et al.*, 1961). Spring water, presumably, rose in quantity: and, since there is now a dug-out pond with water, a little spring water presumably still rises. The water is turbid, with ducks. This bulrush (*Typha domingensis*), is the tall marsh plant expected with pollution. *Arundo donax* presence indicates some dampness over a wider area.

Downstream again a track appears in the wied, then there is a cultivated part where the wied itself has disappeared under the plough: clearly spring water does not flow this far, nor is flood water expected. The channel reappears on the approach to Birzebugia where there is a proper valley, with a dam in a narrow part (the dams on this now very dry wied

are indeed surprising) and a garden wall which is built nearly to the centre where the bed widens. The owners are clearly convinced no flood will ever come. Just downstream of the road bridge is a cultivated area with irrigation water. This has changed over recent years from being more traditional with a stone channel irrigation system, to being more of an ornamental garden. From here, the sea is close.

The central section of the Wied Has-Saptan is of much value, except for bird life, and the upstream and downstream parts are undoubtedly of interest in water (and valley) use features. Nowhere in Malta is rubble piled so high in a valley (yet): so this degree of awfulness at least makes a record! Hunters have huts and nets.

Wied Maqluba, Ghar Lapsi Valley

Most can be seen from the road, and as it lies in open country, the land may be crossed if dangers cannot be seen

Wied Maqluba is another dry wied, on the south coast but without the gorge seen in the other southern ones described (Wied Babu, Wied Has-Saptan). It rises in a rather nondescript and even embayment, with (now) no proper gneiss layer at the base of the scarp, though a scattering of trees there shows some of the expected habitat. The channel curves round the scarp edge, soon becoming a V, with steep, rocky sides, and bushes in the bed (where it is damp and protected enough). The bed widens as it curves away from the hill. The structure of bed and bank remains very appropriately varied and good, and its vegetation, typically terrestrial. Within that there is variation. There are shrubs and trees as well as short plants. The banks are (for a wonder) roughly natural (not man-made) in shape. Clumps of *Arundo donax* confirm a little dampness is present (from the scarp above), and indeed the woody plants are mostly in, not away from, the channel. Downstream the channel becomes U-shaped, nicely patterned with everything except water, though the woody plants become sparser. A wall crosses the channel, and so does a bridge (with tunnels under). From here a flat rock bed, gently incised in rock outcrop, passes down to the sea, close to the Reverse Osmosis plant. With so little soil, vegetation is sparse and of sticky samphire etc. The shoulders of the valley, a tip in the late 1970s have been reclaimed and bear acacia trees. Moreover, further up hill the reclaimed tip is being afforested jointly by the Department of Agriculture

and the International Tree Foundation. Near the base, the (dry) channel is joined by waste water from the reverse osmosis plant running over the rocks.

Those looking at widien should see a variety: and this one, dry, with few features of interest, complements the others in this Appendix. This one should, though, be seen only after several of the others, so that its features can be noticed, and their significance, understood.

We hope you enjoy looking at these widien as much as we, the surveyors and others do! And please remember that formal, signed and posted trails are needed, and that volunteers are needed for these — from readers, we hope.

INDEX OF PLANT NAMES

(From Haslam *et al* (1977), updated by Mr. E. Lanfranco)

LATIN	MALTESE	ENGLISH
<i>Acacia cyanophylla</i> 65, 190, 214	acacia	blue-leaved acacia, blue wattle
<i>Acanthus mollis</i> 61, 64-66	hannewija	bears' breeches
<i>Adiantum capillus-veneris</i> 45, 56, 61, 63, 64, 72	tursin il-bir	maidenhair-fern
<i>Aegilops geniculata</i> 47	brimba	ovate aegilops
<i>Agrostis stolonifera</i> 45		creeping bent
<i>Alisma plantago-aquatica</i> 18, 45, 49, 50, 55, 123, 124, 186, 191, 192, 271	bizbula tal-ilma	water plantain
<i>Allium chamaemoly</i> 47	tewm qerqni	dwarf garlic
<i>Allium dentiferum</i> 47		few-flowered garlic
<i>Allium triquetrum</i> 47		three-cornered garlic
<i>Alopecurus pratensis</i> 44, 45	denb il-gurdien	meadow foxtail
<i>Althaea hirsuta</i> 47	hobbejza sufija	hispid marsh-mallow
<i>Ambrosia maritima</i> 47	mentna	sea ragwort
<i>Ampelodesma mauritanica</i> 45, 70	dis	Mauritanian grass
<i>Anacamptis pyramidalis</i> 46		pyramidal orchid
<i>Anagyris foetida</i> 46, 65	ful il-klieb	stinking bean trefoil, dog-bane
<i>Anogramma leptophylla</i> 45, 56, 72	tursin ir-rih	annual maidenhair, Jersey maiden hair
<i>Anthemis urvilleana</i> 71, 72	bebuna tal-bahar	Maltese sea chamomile
<i>Anthoxanthum odoratum</i> 44, 45		sweet vernal-grass
<i>Anthoxanthum gracile</i> 46		slender vernal-grass
<i>Anthyllis tetraphylla</i> 47		annual kidney vetch
<i>Antirrhinum tortuosum</i> 61	papocci	

<i>Apium graveolens</i> 45	karfus	wild, celery
<i>Apium nodiflorum</i> 17, 49, 68, 183, 245	karfus tal-ilma	fools water cress
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<i>Arundo donax</i> 11, 18, 19, 45, 49, 51, 62, 64, 82, 166, 191, 197, 235, 252, 254, 277, 304	qasab	great reed, cane
<i>Arundo plinii</i> 47, 54, 64, 138, 186	ghaljun	false reed
<i>Asparagus aphyllus</i> 56, 59, 65, 70, 74	sprag xewwieki	Mediterranean asparagus
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<i>Asphodelus aestivus</i> 65	berwieq	small-fruited asphodel
<i>Asphodelus fistulosus</i> 46, 61	berwieq zighr	pink asphodel
<i>Asplenium ceterach</i> 45, 56	ceterak	rusty back fern
<i>Aster squamatus</i> 7, 16, 54, 193, 216, 219	settembrini salvag	narrow-leaved aster,
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<i>Atractylis gummifera</i> 73	xewk tal-miskta	ground thistle
<i>Atriplex prostrata</i> 18, 74	selq il-bahar	spear-leaved orache
<i>Avena barbara</i> 63	hafur	barbed oat
<i>Avena sterilis</i> 63	hafur	animated oat
<i>Bellevalia romana</i> 47	gjacinti salvagg	Roman hyacinth
<i>Bellis annua</i> 65	bebbuna	annual daisy
<i>Bellis sylvestris</i> 45, 55, 65	margerita salvagga	large daisy
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<i>Borago officinalis</i> 62, 63, 69	fidloqqom	borage
<i>Bougainvillea</i> spp. 263		bougainvillea
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<i>Brassica rapa</i> ssp <i>sylvestris</i> 61, 62	liftija	bargeman's cabbage
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<i>Bromus hordaceus</i> 63	hurtam	soft brome
<i>Bromus madritensis</i> 63	bunexxief	compact brome
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<i>Capparis spinosa</i> (incl. <i>C. orientalis</i>) 18, 64	kappar	caper
<i>Cardamine hirsuta</i> 46		hairy bittercress
<i>Carex distans</i> 46, 54	soghda	distant sedge

<i>Carex divisa</i> 46, 54	soghda	divided sedge
<i>Carex divulsa</i> 46, 59	soghda	grey sedge
<i>Carex flacea</i> 46	soghda	glaucous sedge
<i>Carex halleriana</i> 44, 46, 69	soghda tal-makkija	southern sedge
<i>Carex otrubae</i> 46	soghda	false fox-sedge
<i>Carex spicata</i> 46	soghda	spiked sedge
<i>Carya olivaeformis</i> 54, 59	gewz amerikan	pecan nut
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<i>Centaurea solstitialis</i> 47		yellow star-thistle
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<i>Cercis siliquastrum</i> 46	ta' Guda	Judas tree
<i>Cerinthe major</i> 46, 62, 63		large cerinthe
<i>Chara</i> spp. 49, 71, 123		stoneworts
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<i>Chiliadenus bocconei</i> 63, 64, 65, 69, 71	tulliera ta' Malta	Maltese fleabane
<i>Chrysanthemum coronarium</i> 9, 12, 56, 63, 69, 184	lellux	crown daisy
<i>Cistus incanus</i> 46, 47		grey cistus
<i>Cladonia</i> spp. 61, 69		shrubby lichens
<i>Clematis cirrhosa</i> 46, 59, 66, 69	kiesha jew bajda	evergreen travellers' joy
<i>Collema</i> spp. 69		(lichens)
<i>Colocasia esculenta</i> 49	ghorghar	elephant's ear
<i>Conium maculatum</i> 48		hemlock
<i>Convolvulus tricolor</i> 48	leblieb ikhal	three-coloured bindweed
<i>Coronopus squamatus</i> 46		swine-cress
<i>Crassula vaillantii</i> 46		narrow-leaved mossy stonecrop
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<i>Crithmum maritimum</i> 73	busbies il-bahar	sea samphire
<i>Crocus longiflorus</i> 48	zaghran salvagg	yellow-throated crocus
<i>Crucianella rupestris</i> 73	kruanella	rock crosswort
<i>Crupina crupinastrum</i> 47		southern crupinastrum
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<i>Cynoglossum creticum</i> 47	lsien il-kelb	southern hounds' tongue
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<i>Cyperus distachyos</i> 46, 180		Mediterranean galingale
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<i>Cyperus longus</i> 9, 46, 49, 54, 193	bordi	sweet galingale
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<i>Darniella melitensis</i> 72	sigra tal-irmied	Maltese salt-tree
<i>Daucus rupestris</i> 73	zunnarija tal-irdum	cliff carrot
<i>Delphinium halteratum</i> 47	sieg il-hamiema	winged larkspur
<i>Dermatocarpon</i> spp. 69		(lichen)
<i>Diploaxis erucoides</i> 61, 63, 73	gargir	white mustard
<i>Diploaxis viminea</i> 73	gargira zghira	dwarf wall rocket
<i>Dittichia crithmoides</i> 57, 73	xorbett	golden samphire
<i>Dittichia viscosa</i> 5, 7, 9, 11, 18, 19, 47, 72, 73, 189, 192, 193, 197, 216	tulliera	sticky samphire, viscous
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<i>Echinochloa crus-galli</i> 46	xrika	millet grass
<i>Echium sabulicola</i> 47		cockspur
<i>Echium italicum</i> 47	lsien il-fart kbir	sand viper's bugloss
<i>Echium plantagineum</i> 47	lsien il-fart vjola	Italian viper's bugloss
<i>Eichornia crassipes</i> 213, 219		purple viper's bugloss
<i>Elatine gussoni</i> 46		water hyacinth
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<i>Epilobium tetragonum</i> 45, 54, 62		hoary willowherb
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<i>Gastridium phleoides</i> 46		corn cleavers
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<i>Juncus capitatus</i> 44, 180		dwarf rush
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<i>Limonium</i> spp. 71, 72		sea lavender
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<i>Linaria pseudolaxiflora</i> 47		Malta toadflax
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<i>Lotus cytisoides</i> 73	ghantux	shrubby birdsfoot-trefoil
<i>Lotus ornithopodioides</i> 63	qrempuc tal-moghoz	clustered birdsfoot-trefoil
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<i>Lythrum junceum</i> 46, 54, 71		creeping loosestrife
<i>Malope malacoides</i> 44, 47		hairy mallow
<i>Medicago aculeata</i> 47		straight-spined medick
<i>Medicago arabica</i> 46		spotted medick
<i>Medicago intertexta</i> 47	nefel	prickly medick
<i>Medicago littoralis</i> 47	nefel	coastal medick
<i>Medicago murex</i> 47		spiny medick
<i>Medicago polymorpha</i> 47	nefel	toothed medick
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<i>Melilotus infesta</i> 47	trew	round-fruited melilot
<i>Melilotus segetalis</i> 47	trew	corn melilot
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<i>Micromeria microphylla</i> 55, 64, 69	xpakkapietra	Maltese savory
<i>Milium vernale</i> 46		vernal millet
<i>Morus alba</i> 203	cawqli bajda	white mulberry
<i>Muscari neglectum</i> 47		southern grape hyacinth
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<i>Olea europaea</i> 46, 54, 58, 63, 64, 71, 275	zebbug	olive
<i>Ononis mitissima</i> 48		Mediterranean restharrow
<i>Ophrys apifera</i> 46, 180	nahla	bee orchid
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<i>Oxalis pes-caprae</i> 6, 8, 56, 61, 62, 69, 194, 224	haxixa ingliza	hairy broomrape
<i>Palaeocyanus crassifolius</i> 66, 73	widnet il-bahar	cape sorrel
<i>Panicum repens</i> 46, 54		Maltese centuary
<i>Parietaria lusitanica</i> 47	milju salvagg	creeping panic-grass
<i>Periploca angustifolia</i> 47, 55, 74	sigret il-harir	Mediterranean pellitory-of-the-wall
<i>Petalophyllum ralfsii</i> 69		wolfbane
<i>Phagnalon graecum</i> ssp. ginzbergerii 47		(liverwort)
<i>Phalaris minor</i> 47	skalora savagga	eastern phagnalon
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<i>Pistacia lentiscus</i> 46, 59, 69, 71	devu	lentisk
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<i>Plantago lanceolata</i> 46	bizbula salvagga	ribwort plantain
<i>Plantago major</i> 45, 68	bizbula kbira	greater plantain
<i>Plantago serraria</i> 47	bizbula	toothed plantain
<i>Poa trivialis</i> 45		rough meadow-grass
<i>Polygonum glabrum</i> 44, 45		
<i>Polygonum salicifolium</i> 44, 45, 68		willow-leaved knot-grass
<i>Polypogon monspeliensis</i> 54, 57	denb il-liebru	annual beard-grass

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<i>Prunus domestica</i> 46	pruna	plum
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<i>Prunus mahaleb</i> 46		mahaleb cherry
<i>Prunus spinosa</i> 46	pruna salvagga, prajn tax-xewk	blackthorn, sloe
<i>Psoralea bituminosa</i> 63	silla tal-moghoz	blue psoralea, pitch clover
<i>Puccinella fasciculata</i> 45, 49		Borrer's saltmarsh-grass
<i>Punica granatum</i> 46, 222	rummien	pomegranate
<i>Putoria calabrica</i> 44, 55, 56	putorja	stinking madder
<i>Pyrus amygdiformis</i> 46, 71	selvaga	round pear
<i>Pyrus pyrastrer</i> 46	langas salvagg	wild pear
<i>Quecus ilex</i> 47, 59, 275	ballut	evergreen oak, holm oak
<i>Ranunculus bulbosus</i> 44, 54		bulbous buttercup
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<i>Ranunculus chius</i> 45		eastern buttercup
<i>Ranunculus ficaria</i> 211		lesser celandine
<i>Ranunculus fluitans</i> 45, 49, 164		long-leaved water crowfoot
<i>Ranunculus fontanus</i> 45		
<i>Ranunculus muricatus</i> 47, 56, 123, 192		Scilly buttercup
<i>Ranunculus ophioglossifolius</i> 44, 45		adders-tongue, spearwort
<i>Ranunculus saniculaefolius</i> 61		
<i>Ranunculus trichophyllus</i> 45, 49, 55, 58, 123, 193, 206, 308		thread-leaved watercrowfoot
<i>Raphanus raphanistrum</i> 63	ravanell salvagg	wild radish
<i>Rhagadiolus stellatus</i> 47		star hyoseris
<i>Rhamnus alaternus</i> 59	alaternu	Mediterranean buck-thorn
<i>Rhamnus oleoides</i> 61, 71, 74		small buckthorn
<i>Rhus coriaria</i> 46		sumack
<i>Riccia</i> spp. 69		crystalwort, riccia
<i>Ricinus communis</i> 46, 54, 219, 242, 294	rignu	castor oil tree
<i>Rosa gallica</i> 45	warda taz-zejt	Provence rose
<i>Rosa sempervirens</i> 44, 46, 65	ghirlanda tal-wied	evergreen rose
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<i>Rubia peregrina</i> 46, 59		
<i>Rubus ulmifolius</i> 17, 47, 56, 61, 63, 64, 65, 73, 138, 139, 215, 247, 250, 277	harxajja salvagga ghollieq	wild madder bramble, briar, black-berry
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<i>Rumex pulcher</i> 46		
<i>Rumex sanguineus</i> 57		fiddle dock
<i>Ruta chalepensis</i> 61	fejgel	wall rue
<i>Salicornia ramossissima</i> 57	almeridja	twiggy glasswort
<i>Salix alba</i> 44, 47	safsafa	white willow
<i>Salix pedicellata</i> 44, 45	safsafa	Mediterranean willow
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<i>Salvia fruticosa</i> 47	salvja	common sage
<i>Salvia verbenaca</i> 55	salvja salvagga	small sage
<i>Sambucus ebulus</i> 44, 46	sebbuqa salvagga	dwarf elder
<i>Samolus valerandi</i> 45	harira tal-ilma	brookweed
<i>Sanguisorba minor</i> 47	tursin il-ghal	salad burnet
<i>Schoenoplectus lacustris</i> 49		common club-rush
<i>Schoenus nigricans</i> 44, 46		black bog-rush
<i>Scilla autumnalis</i> 72	ghansal tal-harifa	autumn squill
<i>Scilla peruviana</i> 55	ghansal ikhal skur	blue squill
<i>Scirpoides holoschoenus</i> 11, 15, 45, 49, 54, 57, 68, 73, 186, 189, 192, 240, 245, 304	simar	round-headed club-rush
<i>Scirpus maritimus</i> 44, 49		sea club-rush
<i>Scolymus maculatus</i> 45	xewk isfar	spotted golden thistle
<i>Scorpiurus muricatus</i> 47	widna	many-flowered scorpiurus
<i>Scrophularia auriculata</i> 44		water figwort
<i>Sedum sediforme</i> 46, 65, 74		Mediterranean stonecrop
<i>Sedum stellatum</i> 47		starry stonecrop
<i>Selaginella denticulata</i> 69		tooth-leaved club moss
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<i>Spartium junceum</i> 44, 46	genista safra	Spanish broom
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<i>Suaeda vera</i> 57	swejda	shrubby seablite
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<i>Trifolium angustifolium</i> 47	xejm tal-werqa rqieqa	narrow-leaved clover
<i>Trifolium fragiferum</i> 45		strawberry clover
<i>Trifolium nigrescens</i> 63	xnien abjad	small white clover
<i>Trifolium repens</i> 47		white clover
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<i>Trifolium stellatum</i> 47	xejn stilla	starry clover
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